# COASTAL GRIZZLY RESEARCH PROJECT

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# PROGRESS REPORT - YEAR 4 - 1985
# WORKING PLAN - YEAR 5 - 1986

## COASTAL GRIZZLY BEAR RESEARCH PROJECT

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A Cooperative Project Between the Ministries of
Environment and Forests

Wildlife Branch
Ministry of Environment and Parks
Victoria, B.C.

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## ABSTRACT

This report summarizes information gathered to date in the coastal grizzly bear project, outlines proposed management products, and presents the working plan for 1986. Year 4 1985 marked the end of the first phase of the study, the intensive field work in the lower Kimsquit river valley. Results of monitoring grizzly bear movements, home range, and habitat, cover, and food selection are presented and discussed in terms of the potential impacts of logging. Four-year home ranges of two adult female grizzly bears were 30.4 (N=236) and 25.3 (N=241) $km^2$ using the reduced minimum convex polygon method. Two adult female grizzlies spent approximately 30% of their active seasons (1982-1985) in coniferous forests, 40% in floodplain seral habitats, 20% in high elevation units, and 2% in logged areas. Results of testing the accuracy and error estimation of the ground telemetry system are given. Of the 85% of tests that gave closures, only 20% were actually located within the assigned error polygon. Hypothesis-specific summaries are given for research directed to: i) assessing the impact of logging truck traffic on grizzly movements, ii) evaluation of the importance of security cover at high value feeding sites and iii) monitoring the impact of a defoliant herbicide on grizzly bear food production and use in a 5-year-old cutblock. While grizzlies continued to avoid a corridor around the mainline during hauling, there was some indication of habituation in the fall. The pattern of use at a high value salmon feeding site was significantly different after the experimental removal of the adjacent security cover. Grizzly bear use of the 5-year-old block increased in the summer of 1985 but the herbicide was not applied until August, after bear use had declined for the year. An outline is given of the three management products being considered to transfer the results of the research: a list of coastal watersheds ranked in terms of grizzly bear management priority; a model to help determine long term impacts of proposed 5-year forest development plans on grizzly bear habitat capability, and a "users guide" or handbook to provide site-specific prescriptions to minimize the potentially detrimental effects of road and cutblock location, harvest and site treatment methods, and various silvicultural practices. A number of objectives for the 1986 field season and the strategies employed to meet them are given in the working plan. These include: pilot HSI model verification; collection of post-logging food productivity data in the upper Kimsquit, Kitimat and Khutzeymateen watersheds; and, specific follow-up investigations in the lower Kimsquit. Schedules of field work, analysis and reporting are given along with a proposed table-of-contents for the job completion report.

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## 1.0 BACKGROUND

Mainland coastal valleys of British Columbia support some of the highest grizzly bear (Ursus arctos) populations in North America. A mild climate, rich site conditions, and a long growing season make these same valleys highly productive for timber. Some evidence suggests that grizzly bear abundance declines with logging in these forests but it is unclear if these declines are due to habitat change, excessive killing during and post-logging, a combination, or other unidentified factors.

In April, 1982 this research project was initiated to help manage coastal grizzlies in areas being logged or scheduled for logging. The project is cooperatively funded and administered by the Ministries of Environment and Forests. Background, planning and progress reports have been prepared (Archibald 1983; Archibald and Hamilton 1983; Hamilton 1984; Hamilton and Archibald 1984; Archibald et al. 1985).

The following report summarizes information gathered to date, outlines proposed management products, and presents the working plan for 1986.

Numerous individuals, too many to list, have contributed to the coastal grizzly project since 1982. The financial contributions of the U.S. Fish and Wildlife Service and the Canadian Forestry Service are gratefully acknowledged. The continuing logistical support of the University of British Columbia, Doman Forest Products Ltd. and MacMillan Bloedel are also appreciated. Special thanks to L. Giguere, L. Hartman, J. Cofske, and R. Woods.

## 2.0 OBJECTIVES

Project objectives are:

1) to identify seasonal habitat requirements of coastal grizzly bears.
2) to determine the impacts of timber harvest on coastal grizzly bears in the absence of hunting.
3) to determine baseline population characteristics of coastal grizzly bears.

In 1985, efforts were concentrated on meeting objective 2.

## 3.0 STUDY AREA

The study area is in the Kimsquit watershed, located approximately 500 km northwest of Vancouver (Figure 1). Detailed descriptions of the watershed and its location are provided in Hamilton (1984) and Archibald et al. (1985).

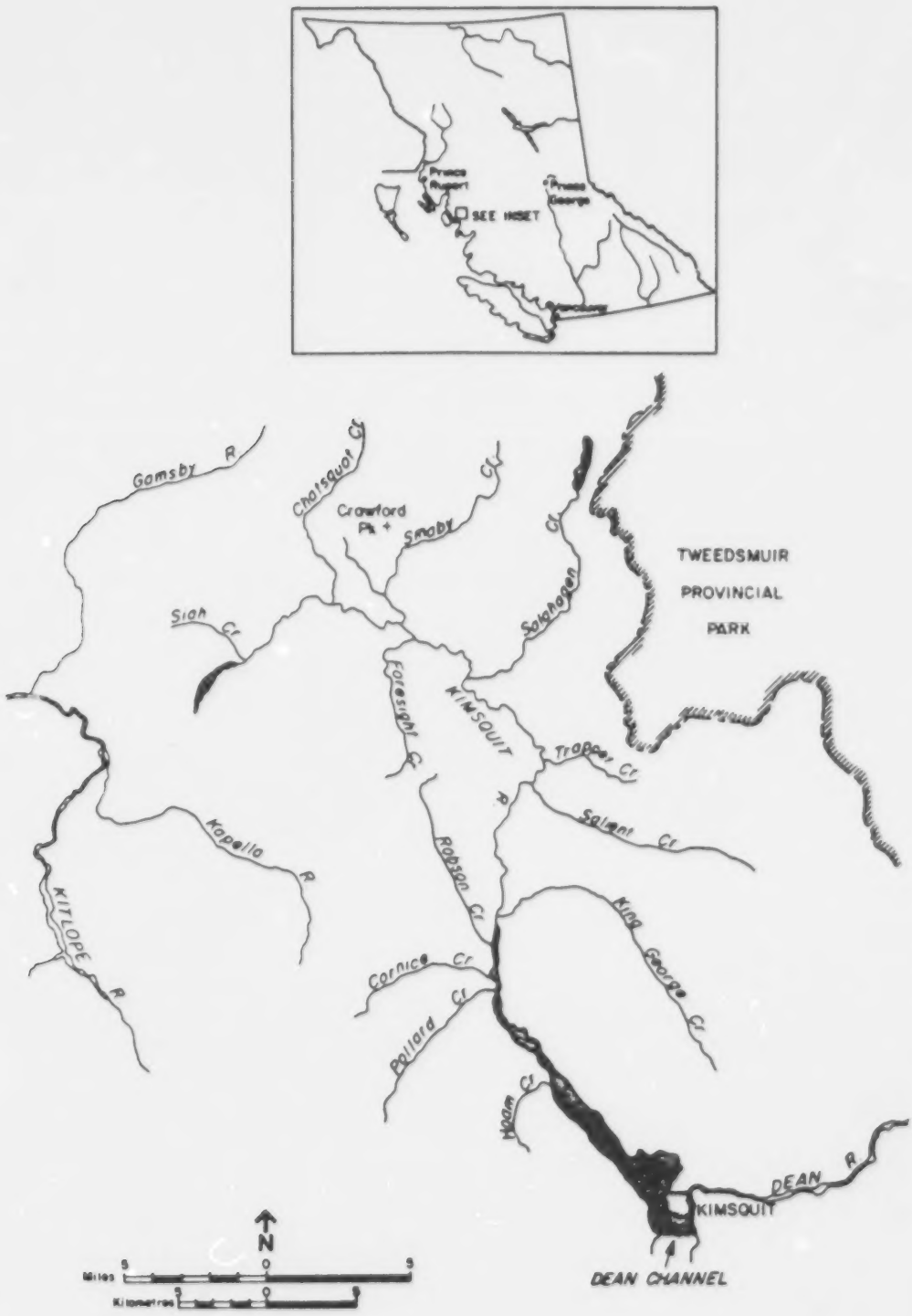



Figure 1. LOCATION OF STUDY AREA

Vegetation in the area has been described in detail by Banner (1985), Banner et al. (1986) and Clement (1984a, 1984b). Habitat mapping was completed at a scale of 1:20 000 using the biogeoclimatic system developed by Krajina (1969). The habitat classification uses an ecological classification based on potential climax vegetation (Yole et al. 1982), modified to accommodate the extensive seral vegetation that develops after geomorphic and logging disturbances.

The biogeoclimatic hierarchy of classification (that is, zone, subzone, and variant; Figure 2) is used by the B.C. Ministry of Forests and the forest industry in their planning. The additional ecosystematic categories within the system enable practical field observations, description, and classification of existing vegetation. Three categories were used to classify and map climax and seral vegetation: the ecosystem association, successional stage, and variation (Banner et al. 1986). When combined, these categories describe the vegetation of any land unit in terms of its potential climax condition, present structure, and present species compostion (Appendix B).

The Kimsquit was partitioned into intensive and extensive areas of study based on the opportunities for data collection. The boundary between them roughly follows the boundary of the Midcoast drier transitional subzone (CWHh - Figure 2). Ground access throughout the watershed is provided by approximately 35 km of logging roads and the navigable river. There is approximately 5 km of road in the extensive study area.

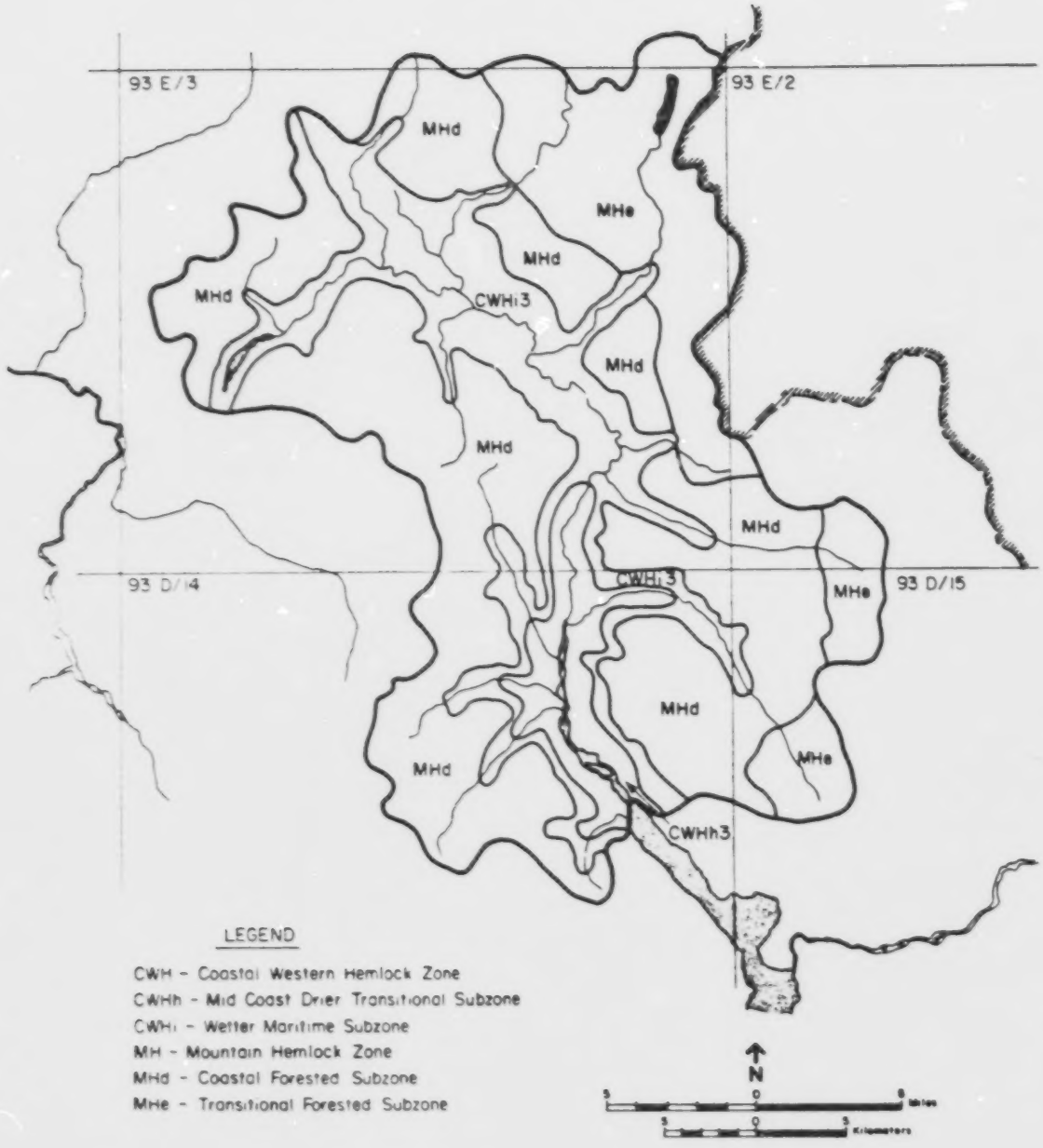



Figure 2. MAP OF FORESTED BIOGEOCLIMATIC SUBZONES OF THE KIMSQUIT RIVER VALLEY

# 4.0 PROGRESS MADE IN 1985-86

## 4.1 Capture

The primary objective of an early spring field session was to re-collar the two intensively monitored adult female grizzlies resident in the lower Kimsquit. A secondary objective was to capture an adult male also thought to be a year-round resident.

Capture methodology is reported in Hamilton (1984). More emphasis was placed on locating cubbies and trail sets in areas of high grizzly bear use identified in 1983, including sites adjacent to skunk cabbage swamps and sedge fens. In addition to building several new road-access cubbies, many of the river-access capture sites first used in 1982 were re-opened.

Trapping began on 16 April and continued until 6 May. Several sites had multiple snares and as many as 22 sets were in use at one time. Three previously marked black bears, three grizzly bears (numbers 08, 53, and 54) and two moose were captured. The still-functioning collars of bear 08 (Marsha) and 53 (Henry) were replaced. Bear 54 (Brutus), an adult male, was fitted with a transmitter on 25 April. Brutus was the only one of the six bears not captured previously. Bear 25 (Shelly) remained in her den for the duration of the trapping session. When she did emerge, she was accompanied by a cub-of-the-year. The two moose were immobilized and released, apparently unharmed by the snare cables. Appendix A lists all bears captured to date.

## 4.2 Home Range

### 4.2.1 Introduction

Home range analysis is most useful as a comparative tool. It allows comparison of movements of individual study animals among seasons and years, as well as similar comparisons among different study animals and study areas. In the present study, home range analyses compared seasonal and annual habitat use patterns to quantify patterns of habitat use and assess the short term impacts of logging on coastal grizzlies. These patterns and impacts were determined by examining shifts in home range size and location over seasons and years, examining changes in annual home range size and location, and examining home ranges pre- and post-logging.

### 4.2.2 Methods

Grizzly bear location information was collected using the methods described in Derocher (1984). The 1985 telemetry schedule consisted of the following:

- daytime ground telemetry from April 10 to May 5
- daytime ground telemetry from June 18 to July 16
- ground telemetry on a 24-h basis from July 17 to September 30

- daytime ground telemetry from October 1 to 4
- aerial telemetry throughout these periods as the opportunity arose.

Accuracy of ground telemetry was examined in 1984 and 1985. Radio collars were placed in known locations throughout the floodplain and attempts were made to "fix" these collars. Distance from the fix to the actual location and presence/absence of the actual location within the error polygon of the fix were recorded.

Home range data were analyzed using two methods. The first type of analysis was the minimum convex polygon (MCP) method that involved the use of a modified version of the HOME program (Harestad 1981). Two MCP home range outlines were examined. One outlined all of the locations in a particular home range (100% outline). The other was chosen to eliminate the effects of outlier locations on home range size (Harestad 1981). This second outline was chosen to include a specified percentage of the data points. The percentage was derived by arranging locations in order of increasing contribution to home range size. Home range size was then plotted as a function of number of locations. When the addition of one more location resulted in a relatively large increase in home range size, that point and all additional points were considered outlier locations. The remaining locations were taken to be the percentage that best represented the home range and this area is referred to as the reduced MCP home range.

The second analysis of home range data used the CENTRE program (Harestad 1981) to calculate harmonic mean measures of home ranges, including harmonic mean centre, harmonic moments, and harmonic distance deviation. Harmonic distance deviation gives a measure of variation of the locations about the harmonic mean centre (Harestad 1981). Harmonic moments for each point give a measure of that point's position with respect to all locations. This program was modified to generate contoured plots of harmonic moments of location data. The data were analyzed on a 100 m grid interval. Harmonic contour levels were determined in a manner similar to that used to determine outline percentages for the MCP method. Two contour levels were examined. The first was chosen such that it was the smallest contour that included all location points (100% contour home range). In the second case, harmonic moments were plotted as a function of locations that were successively further from the harmonic mean centre of the home range. When the addition of one more location resulted in a relatively large increase in harmonic moment, that point and all others with larger harmonic moments were considered outliers. The contour level was set such that it was the minimum contour that outlined all non-outlier points and was referred to as the reduced contour home range. These contours were digitized to determine home range area. This type of analysis has been done to try to overcome some of the problems in home range analysis discussed in Archibald et al. (1985). The method of harmonic measures of home ranges has advantages over the MCP method in that it is a closer approximation of the true centre of activity (Dixon and Chapman 1980).

4.2.3 Results

Of the 62 tests of ground telemetry accuracy, fixes were obtained for 53 (85%). Only 11 (20%) of these 53 had the actual location of the test collar located within the error polygon of the fix. The mean distance from the fix to the actual location was 262 m (range = 1671 m, SD = 317 m). The majority of the fixes were within 250 m of the actual location of the test collar (Table 1).

As a result of the test telemetry, only aerial and verified ground telemetry locations were used in the home range analyses. Home ranges were examined seasonally, annually, and over all years (1982 - 1985). Data presented here are for bears that were monitored in 1985. Of these, Shelly had the most locations (241) and Brutus the least (31). The modified MCP home ranges contained between 80% and 96% of the locations in a home range. Contour home ranges were determined for Marsha and Shelly's overall and seasonal home ranges as test cases. Contour home ranges have not yet been determined for their annual home ranges or for any home ranges of Heather, Henry or Brutus.

Table 2 presents an overall home range summary for the five bears monitored in 1985. Only Marsha and Shelly's overall home range information is complete. The dramatic increase in Henry's 100% overall MCP home range from 1984 is due to two locations in the upper Kimsquit valley. Reduced contour home ranges for Marsha and Shelly roughly correspond to those of the reduced MCP home range sizes. Harmonic distance deviations range from 514 m to 786 m (Table 2). Table 3 is a summary of annual home ranges for Marsha and Shelly. Marsha's annual home ranges were much larger than those of Shelly's. Shifts in harmonic mean centre between years averaged 963 m for the two bears: 1520 m for Shelly and 406 m for Marsha. Except for 1982, harmonic distance deviations for Shelly were greater than those of Marsha (Table 3). Seasonal home ranges for Heather, Henry, and Brutus are presented only for those seasons for which sufficient data were available (Table 4). Marsha's MCP seasonal home ranges were, on the average, largest of the five bears. Except for Brutus, home range sizes for seasons five and six were smaller than those of the rest of the seasonal home ranges. Sample sizes for season 7 were too small to allow accurate estimates of home range sizes. Seasonal contour home range sizes were very different than seasonal MCP home range sizes. This is probably due to a tendency to outline areas of centre of activity, resulting in home ranges described by disjoint areas. Average shifts in seasonal harmonic mean centres were 4248 m for Marsha and 2071 m for Shelly. Seasonal distance deviations tended to be smallest for Heather, Henry and Brutus and largest for Marsha.

4.3 Habitat use

4.3.1 Introduction

To achieve project objectives 1 and 2 (section 2.0) requires an understanding of how grizzly bears use their habitat on a daily, seasonal,

Table 1. Distance of test telemetry fix from actual test collar location

| | Distance of fix from actual location (m) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 0-50 | 51-100 | 101-150 | 151-200 | 201-250 | 251-500 | 501-750 | 751-1000 | 1001-1500 | 1501-2000 |
| # of fixes | 9 | 12 | 3 | 9 | 5 | 7 | 5 | 1 | 1 | 1 |

Table 2. Overall home ranges for radio-collared bears monitored in 1985

| Bear | Number of locations | MCP home range size($km^2$) | | Contour home range size($km^2$) | | Harmonic measures | | |
|---|---|---|---|---|---|---|---|---|
| | | 100% outline | Reduced outline[a] | 100% outline | Reduced outline[a] | Mean centre (UTM coordinates) | | Distance deviation (m) |
| Marsha | 236 | 85.5 | 30.4 | 60.2 | 32.4 | 624900 | 5867400 | 702 |
| Shelly | 241 | 59.6 | 25.3 | 154.6 | 18.1 | 626900 | 5863000 | 786 |
| Heather | 34 | 12.7 | 9.6 | | | 624900 | 5867600 | 533 |
| Henry | 51 | 159.4 | 14.5 | | | 625600 | 5865100 | 604 |
| Brutus | 31 | 9.3 | 5.5 | | | 627300 | 5863000 | 514 |

[a] home range outline after removal of outlier locations.

Table 3. Annual home ranges for Marsha and Shelly

| Bear | Year | Number of locations | MCP home range size($km^2$) | | Harmonic measures | | |
|---|---|---|---|---|---|---|---|
| | | | 100% outline | Reduced outline[a] | Mean centre (UTM coordinates) | | Distance deviation (m) |
| Marsha | 1982 | 21 | 28.7 | 11.9 | 625000 | 5866900 | 585 |
| | 1983 | 90 | 50.5 | 22.7 | 624900 | 5867400 | 611 |
| | 1984 | 64 | 43.0 | 21.0 | 624900 | 5867400 | 605 |
| | 1985 | 61 | 70.8 | 23.2 | 624400 | 5867900 | 587 |
| Shelly | 1982 | 17 | 13.5 | 3.9 | 627200 | 5873000 | 491 |
| | 1983 | 82 | 32.8 | 10.9 | 626300 | 5864100 | 757 |
| | 1984 | 86 | 46.4 | 9.2 | 627200 | 5862900 | 703 |
| | 1985 | 62 | 44.9 | 8.7 | 626200 | 5864200 | 744 |

a home range outline after removal of outlier locations.

Table 4. Seasonal home ranges for radio-collared bears monitored in 1985

| Bear | Season | Number of locations | MCP home range size ($km^2$) 100% outline | MCP home range size ($km^2$) Reduced outline[a] | Contour home range size($km^2$) 100% outline | Contour home range size($km^2$) Reduced outline[a] | Harmonic measures Mean centre (UTM coordinates) | | Harmonic measures Distance deviation(m) |
|---|---|---|---|---|---|---|---|---|---|
| Marsha | 2 | 19 | 30.4 | 23.2 | 1.2 | 0.4 | 623600 | 5870400 | 770 |
| | 3 | 28 | 41.2 | 29.6 | 4.2 | 1.6 | 629200 | 5861300 | 729 |
| | 4 | 50 | 39.3 | 8.5 | 13.8 | 11.3 | 624400 | 5866700 | 657 |
| | 5 | 72 | 5.1 | 2.9 | 11.6 | 4.7 | 624900 | 5867500 | 466 |
| | 6 | 51 | 6.7 | 4.2 | 8.9 | 5.0 | 625100 | 5867300 | 478 |
| | 7 | 7 | 6.2 | 0.9 | 0.9 | 0.3 | 626000 | 5865400 | 270 |
| Shelly | 2 | 28 | 21.9 | 5.5 | 11.8 | 3.9 | 627600 | 5861500 | 410 |
| | 3 | 25 | 16.3 | 6.2 | 7.4 | 3.7 | 629200 | 5861300 | 380 |
| | 4 | 67 | 35.7 | 12.5 | 34.8 | 7.6 | 627000 | 5862900 | 575 |
| | 5 | 58 | 6.6 | 4.5 | 10.9 | 6.3 | 625500 | 5865300 | 471 |
| | 6 | 55 | 5.1 | 4.1 | 7.7 | 4.3 | 626900 | 5863200 | 525 |
| | 7 | 8 | 3.3 | 1.8 | 0.5 | 0.3 | 627200 | 5862700 | 405 |
| Heather | 5 | 13 | 4.9 | 2.8 | | | 624900 | 5867600 | 447 |
| | 6 | 17 | 6.3 | 6.3 | | | 625200 | 5867100 | 480 |
| Henry | 4 | 12 | 3.8 | 1.7 | | | 625300 | 5865700 | 392 |
| | 5 | 13 | 2.6 | 1.8 | | | 625100 | 5866400 | 335 |
| | 6 | 15 | 21.2 | 2.9 | | | 625800 | 5864500 | 414 |
| Brutus | 5 | 16 | 8.4 | 8.4 | | | 624900 | 5866500 | 441 |
| | 6 | 14 | 1.3 | 0.9 | | | 627400 | 5862900 | 303 |

a home range outline after removal of outlier locations.

and annual basis. Most habitat use data collected to date were re-analyzed in 1985 to include 1985 field data, to evaluate different analytical approaches, and to examine the potential of different summary and presentation techniques. Emphasis in 1985 was placed on the role of forage in habitat selection (Hamilton and Bunnell, in press; Hamilton, in prep.) and on habitat unit evaluation to provide the background information required to assess the impacts of forest practices.

4.3.2 Methods

Information on grizzly habitat use patterns was gathered during site investigations conducted in areas of recent grizzly activity. These sites were selected on the basis of verified ground telemetry relocations of radio-collared bears, through direct observation of grizzlies, or were located in known areas of traditional grizzly use. Ground telemetry locations having an uncertainty area of less than one hectare were investigated after the bear left the vicinity. Activity information was recorded if the exact site and date of use could be confirmed, and if the bear responsible was definitely grizzly. Track characteristics (Lloyd 1979) and hair colour, thickness, and length were used to confirm species identification. Where possible, activities were assigned to specific bears. Direct visual observations, periodic checks in areas of traditional grizzly use, and chance encounters with grizzly bear sign also provided records of activity. Additional habitat information was gained from aerial telemetry.

Site investigations were conducted in 1983, 1984, and 1985. Information collected included: security cover value and distance to an opening; soil type and canopy coverage of trees, shrubs, and herbs; age of sign; and bed, mark tree and mark trail measurements (Appendix C) (Hamilton and Archibald 1986). Activities were classified as feeding, bedding, tree marking, trail marking, travelling, and other. Typically, more than one activity was recorded per site.

"Habitat types" (ecosystem associations or variations - Appendix B) were assigned to each grizzly activity site and aerial location. For aerial locations, only the suspected habitat type of the centre point of the assigned uncertainty area was used for these analyses.

Habitat types have been grouped into more general bear habitat units (BHU's) based on their physiographic location, seral stage, and dominant vegetative cover. BHU's were developed primarily to enable extrapolation of project results to other watersheds where detailed ecosystematic mapping may not be available. Most BHU's can be identified on standard B.C. Government 1:20 000 black and white aerial photographs, and relate to observed seasonal grizzly habitat selection.

For the Kimsquit, BHU's have been cross-referenced to the forest cover classification system used by the Ministry of Forests (Table 5). Criteria used to correlate units were: i) dominant tree species vs. tree prominence values (Banner et al. 1986) ii) site, height, and stocking class vs.

Table 5. Bear habitat units (BHU's) for the Kitsequit study area

| BHU | Acronym | Ecosystem Units[a] | Forest Cover Units[b] |
|---|---|---|---|
| Sidehill and Bench Seral/ Avalanche Chute | AC | CWHh301A<br>CWHh301C * (C4)<br>CWHh303A<br>CWHh303B<br>CWHh303C<br>CWHh304A<br>CWHh304C * (C2) If not over F1 or F2<br>CWHh304E<br>CWHh305B<br>CWHh305C * (C7) If not over F1 or F2<br>CWHl301A<br>CWHl301C<br>CWHl301D<br>CWHl302A<br>CWHl302C<br>CWHl304B<br>CWHl305A<br>CWHl305C<br>CWHh309B<br>CWHh309C<br>CWHl308A<br>CWHl308B<br>CWHl308C<br>MHd05A<br>MHd05B<br>MHd05C | See sidehill and bench oldgrowth: If age less than or equal to class 5 (81-100 yrs) then BHU equals AC.<br><br>or: NPBr on Sidehills |
| Sidehill and Bench Climax and Oldgrowth | SO | CWHh301F * (F1, F2, F3)<br>CWHh301G * (G1, G2)<br>CWHh301H<br>CWHh304F If not over F1 or F2<br>CWHh304G<br>CWHh305F<br>CWHh305G If not over F1 or F2<br>CWHh305H<br>CWHl301F<br>CWHl301G<br>CWHl305F<br>CWHl305G<br>CWHh301E<br>CWhh303E<br>CWHh304E | BaHwCw HwBaFdCw<br>BaSsHw HwBaSs<br>CwSs HwCw<br>CwHw HwCwBa<br>CwSsHw HwCwSs<br>FdBaHw HwFdBa<br>FdCwSs HwFdCwBa<br>FdHwBa HwSs<br>FdHwSs HwSsBa<br>Hw HwSsCw<br>HwBa (on G or M site)<br>HwBaCw HwSsCwFd<br>HwBaFd SsBaHw<br>SsHwCw SsCwHw |

Table 5 (cont'd)

| BHU | Acronym | Ecosystem Units[a] | Forest Cover Units[b] |
|---|---|---|---|
| Subalpine Parkland Alpine Tundra | SA | MHd02A<br>MHd02C<br>MHd02F<br>MHd02G<br>MHd02H<br>MHd03G<br>MHdp01A<br>MHdp01G<br>MHdp03B<br>MHdp03G<br>MHd01A<br>MHd01C<br>MHdp01A<br>MHdp02G | A For<br>A |
| Subalpine Forest | MH | MHd01F<br>MHd01G<br>MHdp01G<br>MHdp02H | Ba<br>BaHw<br>HwBa (on L or P site) |
| Dry Shore Pine | PL | CWHh302A<br>CWHh302B<br>CWHh302C<br>CWHh302F<br>CWHh302G | FdHwPl<br>FdPl<br>FdPlCw<br>FdPlHw<br>HwPl<br>Pl<br>PlFd<br>$PlH_w$<br>PlHwFd |
| Submesic no Ba | SM | CWHh303F<br>CWHh303G<br>CWHh302F<br>CWH1302G | CwHwFd<br>Fd<br>FdCw<br>FdCwHw<br>FdHw<br>FdHwCw<br>HwCwFd<br>HwFd<br>HwFdCw<br>These units in Sm only if on L or P sites. If on M or G they are in SO. |
| Swamps | SS | CWHh307E * (E1)<br>CWHh307F<br>CWHh307G<br>CHWh307G | |
| Sedge Fen | SF | CWH1309B<br>MHd04B<br>CWHh308G | Swamp Symbol |

Table 5 (cont'd)

| Type | Acronym | Ecosystem Units[a] | Forest Cover Units[b] |
|---|---|---|---|
| Logged | LG | CWHh3_ _CL | None on Kitsquit Map. |
| Floodplain Seral (Non-Forested) | FS | CWHh306A * (A8)<br>CWHh306B * (B8)<br>CWHh306C * (C7,C8)<br>CWHh304A * (C2) If over F1<br>CWHh304C or F2<br>CWHh305B If over<br>CWHh305C * (C7) F1 or F2 | NPBr on Floodplain |
| Floodplain Seral (Forested) | FF | CWHh306D * (D5,D6,D9,D10)<br>CWHh306E * (E1,E2,E3,E4)<br>CWHh304E<br>CWHh305D * (D5) If over<br>CWHh305E * (E1,E4) F1 or F2 | Dr<br>DrAc<br>DrAcSs<br>Ac<br>AcDr<br>AcHw<br>AcSs<br>AcSsCw |
| Floodplain Climax and Oldgrowth | FO | CWHh306F * (F1)<br>CWHh306G<br>CWHh306H<br>CWHh304F If over<br>CWHh304G * (G1) F1 or F2<br>CWHh305F<br>CWHh305G If over<br>CWHh305H F1 or F2 | Ss If age class greater than<br>SsHw or equal to class 6.<br>SsHwAc (101-120). If less than<br>SsAc BHU equals FS.<br>SsAcHw<br>SsDr |
| Estuary | Ey | CWHh310 | No label on Kitsquit Map. |

[a] see Banner (1985) and Clement (1984a and b) for unit names and descriptions.

[b] Forest Cover Units - dominant species as follows:

A - Alpine
A For - Alpine Forest
Ac - Black Cottonwood
Ba - Pacific Silver Fir
Cw - Western Red Cedar
Dr - Red Alder
Fd - Douglas Fir
Hw - Western Hemlock
NPBr - Non-productive Brush
Pl - Lodgepole Pine
Ss - Sitka Spruce

* = Unit has variations - these are listed inside brackets.

ecological moisture and nutrient regime iii) age class vs. seral stage (Appendix B). Attempts at cross-walking ecological and forest cover types in the Kimsquit have demonstrated that additional information will be required to apply this technique elsewhere on the coast, e.g. slope, aspect, and elevation. Successfully cross-referenced ecological and forest cover units would allow identification of bear habitat directly from forest cover maps.

Seasons of grizzly bear activity, as defined by Lloyd (1979), were adapted to the Kimsquit study area. Eight seasons were identified, based on plant phenology and the availability of preferred foods.

In 1983 and 1984, plant species lists were completed at verified grizzly bear feeding, bedding, and marking sites. Percent ground cover, height class, distribution and vigour were recorded for each species in a 20 x 20 m plot centred within the activity. Percent cover totals of all plant species in each of five height classes or strata were also estimated. Classes were: trees, high shrubs (2 - 10 m), low shrubs (0 - 2 m), herbs, and mosses (Walmsley et al. 1980). Most statistical analyses were conducted using SAS (SAS Institute Inc., Anonymous 1985a). Summary statistics (e.g. means, ranges, standard deviations) were calculated for continuous variables. Non-parametric techniques also were used because most categorical variables were not normally distributed. Significant differences in mean strata coverage were sought between sites in security cover and sites in openings for each primary activity and season. Because of non-normal data, (Shapiro-Wilk statistic for sample sizes less than 51 and Kolmogorov statistic for sample sizes greater than 50 (Anon. 1985a), a non-parametric ANOVA (Anon. 1985b) was used. When significant differences were discovered, their origin was identified using a non-parametric multiple range test (Zar 1984). The selected level of significance was alpha = .05.

Use/availability data were processed by a FORTRAN program adapted from Woods et al. (in prep.). This analysis calculates a chi-square approximation as a test for an overall difference in use and availability within an analysis class (Neu et al. 1974). Expected use confidence intervals are then produced using Bonferroni Z-statistics (Neu et al. 1974). These were compared to the actual use information. If actual use was outside the confidence interval, then it was not proportional to availability. Preference values were also calculated (Hanley 1984). Large deviations from a value of 1.0 indicate that use and availability percentages are not the same (Woods et al., in prep.).

### 4.3.3 Results and Discussion

The first grizzly bear activity site investigation conducted in 1985 was on 8 July. Between 8 July and 3 October, use information was recorded at 212 sites. Of these, 71 (33%) had been used in 1983 and/or 1984. Since May 1983, 1152 activities have been recorded at 659 sites for at least 15 different grizzlies (Table 6).

Table 6. Activity records by bear from site investigations, 1983-1985

| | Activity | | | | | | |
|---|---|---|---|---|---|---|---|
| Bear Name | Bedding | Feeding | Mark Tree | Mark Trail | Travel | Other | Total |
| Marsha | 72 | 80 | 11 | 6 | 81 | 3 | 253 |
| Shelly | 79 | 94 | 0 | 1 | 87 | 5 | 266 |
| Large male(s) | 10 | 12 | 6 | 8 | 23 | 0 | 59 |
| Heather | 11 | 14 | 1 | 0 | 17 | 0 | 43 |
| Siblings 2-1/2 yrs. | 4 | 5 | 0 | 0 | 7 | 2 | 18 |
| Shelly & male | 4 | 8 | 3 | 2 | 6 | 0 | 23 |
| Female(s) with COY[a] | 3 | 5 | 0 | 0 | 13 | 0 | 21 |
| Unknown sub-adult | 1 | 5 | 0 | 0 | 9 | 0 | 15 |
| Unknown grizzly | 89 | 74 | 45 | 35 | 95 | 2 | 340 |
| Henry | 21 | 17 | 3 | 0 | 28 | 0 | 69 |
| Brutus | 17 | 12 | 0 | 2 | 14 | 0 | 45 |
| TOTAL | 311 | 326 | 69 | 54 | 380 | 12 | 1152 |

[a] COY = cub(s)-of-the-year.

The timing and duration of seasons given in Archibald et al. (1985) were altered (Table 7). Although the broad habitat use patterns remained the same, climate differences led to different seasonal start dates. After a winter that was relatively snow free at low elevations, Marsha was observed approximately 75 m from the valley floor on 17 March. This is one of the very few locations collected during season 1 as most bears appear to still be in their dens. The 71-day duration of season 3 in 1985 was longer than average (Table 7). Shelly and Marsha did not leave the side tributaries (avalanche chutes) until early July, when they began to use the floodplain habitats. The pattern of habitat use in season 5 was also different. More sidehill feeding on berries was observed than previous years, possibly a result of extremely hot weather. Low water levels in August appeared to delay the onset of salmon spawning. Eighty-seven percent of the activities investigated since 1983 were in seasons 4, 5, and 6, when bear movement is concentrated on the floodplain (Table 8).

#### 4.3.3.1 Habitat selection

The data bases for examining habitat selection were frequencies of location of collared bears and estimates of time (beardays) spent in each habitat. Non-uniform ground telemetry coverage resulted in grizzly frequency of location data with potentially misleading biases (Archibald et al. 1985). To help eliminate these biases, efforts in 1985 were directed to the calculation and comparison of beardays between seasons and bears. Percent beardays and frequency of location by ecosystem variation and seral stage are contrasted in Table 9. The contrast is evident for variations of the h306 (Floodplain spruce-devil's club) association (Appendix B). Sixty-seven percent (N=162) of all Shelly's active season locations (seasons 1-7) were in this association. However, this association accounts for only 56% of her active season beardays. Similarly, 47% (N=107) of Marsha's locations in the h306 can be compared to 40% of her active season beardays.

Frequency summaries can demonstrate the relative use of units selected for short duration visits. For example, Shelly was located in the h308G (Non-forested wetlands) on six occasions (2.5%). Her percentage of beardays (active season) for this association is just 1.7%. Marsha was found in the h308G three times (1.3%) for 0.3% of her active season beardays. Feeding and travel account for 93% of all activities recorded in this habitat by both bears (N=14). The lack of bedding activity records and the small bearday total suggest that visits were not of long duration. The relative use of such units could be underestimated by the "bearday" technique.

Similar to location frequency summaries, summaries of activities by ecosystem variation (Table 10) were also potentially biased due to non-uniform ground telemetry coverage. Unlike location information, activity data were collected at site investigations resulting from ground rather than a combination of ground and aerial telemetry. Variations subject to lower accuracy and precision of ground telemetry may be under-represented in the activity sample. Such biases were not likely manifested at the association level of the habitat classification. When the 542 activities of Shelly and

Table 7. "Seasons" of grizzly bear activity in the Kimsquit valley, British Columbia

| Season Number | Start | Definition | Season Length (days) 1982 | 1983 | 1984 | 1985 | Average Season Length (Days) |
|---|---|---|---|---|---|---|---|
| 1 | Early April | Emergence to valley floor leaf flush | - | 6 | 4 | 6 | 5 |
| 2 | Mid-April | Leaf flush to avalanche chute green up | - | 24 | 44 | 35 | 34 |
| 3 | Late May | Avalanche chute green up to berry production | 45 | 31 | 34 | 71 | 45 |
| 4 | Late-June | Berry production, no salmon | 27 | 42 | 36 | 27 | 33 |
| 5 | Late July | Berries and salmon | 35 | 35 | 40 | 36 | 37 |
| 6 | Late August | Salmon, no berries | 45 | 45 | 33 | 29 | 38 |
| 7 | Mid-October | Post-salmon | 16 | 8 | 17 | - | 14 |
| 8 | Early November | Denning | 166 | 160 | 141 | - | 156 |

Table 8. Number of activities investigated per season for all bears, 1983 - 1985

| Activity | Season | | | | | |
|---|---|---|---|---|---|---|
| | Two | Three | Four | Five | Six | Seven |
| Bedding | 11 | 10 | 34 | 116 | 130 | 10 |
| Feeding | 20 | 16 | 85 | 109 | 91 | 5 |
| Mark tree | 10 | 6 | 23 | 10 | 18 | 2 |
| Mark trail | 5 | 5 | 10 | 17 | 15 | 2 |
| Travel | 18 | 13 | 91 | 108 | 141 | 9 |
| Other | 3 | 1 | 1 | 2 | 4 | 1 |
| Total [a] | 67 | 51 | 244 | 362 | 399 | 29 |

[a] Discrepancies with Table 4 in Archibald et al. 1985 are a result of re-definition of seasons' 3 and 7 start/finish dates.

Table 9. Percent bear days and frequency of location by ecosystem variation and seral stage for Shelly and Marsha, all active season locations, 1982 - 1985, N = 241 and 236, respectively

| Ecosystem Unit | BHU | Percent bear days | | Frequency of location | |
|---|---|---|---|---|---|
| | | Shelly | Marsha | Shelly | Marsha |
| H301CL | LG | 0.0 | 1.1 | 0 | 6 |
| H301E | SO | 1.2 | 0.0 | 2 | 0 |
| H301F | SO | 1.1 | 0.0 | 2 | 0 |
| H301G | SO | 0.9 | 9.2 | 2 | 9 |
| H301G1 | SO | 0.1 | 0.1 | 1 | 1 |
| H301H | SO | 0.2 | 0.0 | 1 | 0 |
| H302G | PL | 0.0 | 1.3 | 0 | 1 |
| H303F | SM | 0.4 | 3.3 | 1 | 2 |
| H303G | SM | 2.5 | 0.9 | 9 | 3 |
| H304CL | LG | 0.0 | 0.1 | 0 | 1 |
| H304F | SO | 1.8 | 0.3 | 3 | 3 |
| H305C | FS | 0.0 | 0.3 | 0 | 1 |
| H305CL | LG | 0.5 | 1.3 | 3 | 9 |
| H305D | FF | 0.7 | 0.1 | 3 | 2 |
| H305E1 | FF | 0.4 | 3.7 | 2 | 11 |
| H305E4 | FF | 0.0 | 3.0 | 0 | 11 |
| H305F | FO | 4.3 | 3.3 | 9 | 11 |
| H305G | FO | 2.0 | 0.4 | 4 | 4 |
| H305H | FO | 0.0 | 0.5 | 0 | 1 |
| H306B8 | FS | 3.7 | 2.2 | 15 | 8 |
| H306C8 | FS | 5.3 | 3.7 | 22 | 13 |
| H306D5 | FF | 6.2 | 4.2 | 17 | 15 |
| H306D6 | FF | 1.3 | 1.3 | 4 | 5 |
| H306D9 | FF | 2.0 | 2.9 | 10 | 6 |
| H306E1 | FF | 6.9 | 4.3 | 18 | 16 |
| H306E2 | FF | 3.6 | 1.1 | 12 | 3 |
| H306E3 | FF | 11.5 | 12.1 | 26 | 18 |
| H306E4 | FF | 8.6 | 3.6 | 19 | 12 |
| H306F | FO | 1.4 | 0.8 | 8 | 3 |
| H306H | FO | 5.2 | 3.4 | 11 | 8 |
| H307E | SS | 1.5 | 0.1 | 4 | 1 |
| H307F | SS | 0.3 | 0.5 | 1 | 1 |
| H307G | SS | 0.0 | 0.9 | 0 | 2 |
| H308G | SF | 1.7 | 0.3 | 6 | 3 |
| H309C | AC | 1.5 | 0.4 | 4 | 1 |
| I301A | AC | 1.2 | 0.0 | 1 | 0 |
| I301F | SO | 0.7 | 0.0 | 1 | 0 |
| I301G | SO | 0.8 | 3.1 | 1 | 5 |
| I302G | SM | 0.0 | 4.6 | 0 | 4 |
| I308A | AC | 0.0 | 1.9 | 4 | 2 |
| I308B | AC | 0.0 | 1.1 | 0 | 1 |
| I308C | AC | 3.6 | 15.3 | 0 | 15 |
| D01A | SA | 0.9 | 0.0 | 1 | 0 |
| D01G | MH | 7.7 | 0.0 | 4 | 0 |
| D02G | SA | 0.0 | 1.1 | 0 | 1 |
| D05C | AC | 6.4 | 0.0 | 2 | 0 |
| Estuary | EY | 1.5 | 1.1 | 6 | 3 |
| Road | NV | 0.1 | 1.1 | 1 | 5 |
| Camp | NV | 0.3 | 0.0 | 1 | 0 |

Table 10. Frequency of activity by ecosystem variation and seral stage for Shelly and Marsha for 1983 and 1984 [a]

| Eco-System Unit | Activity | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Bedding | Feeding | Mark tree | Mark trail | Travel | Other | Total | Percent |
| H301CL | 0 | 1 | 0 | 0 | 6 | 0 | 7 | 1.3 |
| H301E | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 0.2 |
| H301F | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 0.2 |
| H301G | 4 | 2 | 0 | 0 | 1 | 0 | 7 | 1.3 |
| H301G1 | 1 | 1 | 0 | 0 | 0 | 0 | 2 | 0.4 |
| H301H | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 0.2 |
| H303F | 1 | 0 | 0 | 0 | 1 | 1 | 3 | 0.5 |
| H303G | 3 | 1 | 0 | 0 | 0 | 0 | 4 | 0.7 |
| H303G2 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 0.2 |
| H304CL | 0 | 1 | 0 | 0 | 1 | 0 | 2 | 0.4 |
| H304F | 2 | 1 | 1 | 1 | 1 | 1 | 7 | 1.3 |
| H305CL | 3 | 9 | 0 | 0 | 7 | 0 | 19 | 3.5 |
| H305D | 2 | 2 | 0 | 0 | 1 | 0 | 5 | 0.9 |
| H305E1 | 8 | 6 | 0 | 1 | 0 | 0 | 15 | 2.8 |
| H305E2 | 2 | 1 | 0 | 0 | 0 | 0 | 3 | 0.5 |
| H305E4 | 6 | 1 | 0 | 0 | 1 | 0 | 8 | 1.5 |
| H305F | 8 | 9 | 2 | 2 | 5 | 1 | 27 | 5.0 |
| H305G | 4 | 3 | 3 | 1 | 2 | 0 | 13 | 2.4 |
| H305H | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0.2 |
| H306B8 | 7 | 8 | 0 | 0 | 22 | 1 | 38 | 7.0 |
| H306C8 | 9 | 15 | 0 | 0 | 26 | 2 | 52 | 9.6 |
| H306D5 | 14 | 16 | 0 | 1 | 11 | 1 | 43 | 7.9 |
| H306D6 | 5 | 5 | 1 | 0 | 6 | 0 | 17 | 3.1 |
| H306D9 | 10 | 7 | 1 | 1 | 5 | 0 | 24 | 4.4 |
| H306E1 | 8 | 14 | 2 | 0 | 16 | 1 | 41 | 7.6 |
| H306E2 | 3 | 9 | 0 | 0 | 9 | 0 | 21 | 3.9 |
| H306E3 | 18 | 11 | 0 | 1 | 1 | 0 | 41 | 7.6 |
| H306E4 | 14 | 18 | 0 | 0 | 12 | 0 | 44 | 8.1 |
| H306F | 6 | 5 | 1 | 1 | 4 | 0 | 17 | 3.1 |
| H306H | 11 | 11 | 1 | 0 | 8 | 0 | 31 | 5.7 |
| H307E | 0 | 4 | 0 | 0 | 3 | 0 | 7 | 1.3 |
| H307F | 0 | 2 | 1 | 0 | 0 | 0 | 3 | 0.5 |
| H307G | 0 | 2 | 0 | 0 | 2 | 0 | 4 | 0.7 |
| H308G | 1 | 8 | 0 | 0 | 6 | 0 | 15 | 2.7 |
| H309C | 1 | 3 | 0 | 0 | 2 | 0 | 6 | 1.1 |
| Estuary | 0 | 6 | 0 | 0 | 3 | 0 | 9 | 1.7 |
| Road | 0 | 0 | 0 | 0 | 2 | 0 | 2 | 0.4 |
| Total | 155 | 182 | 14 | 9 | 174 | 8 | 542 | |

[a] From site investigations only - does not include aerial location habitat use data.

Marsha (recorded at 307 sites) are examained (Table 10), the relative importance of the h306 association is again obvious (68% of all records). In addition, analysis to date suggests that the relative use of a habitat by activity type is uniform across all occurrences of that unit. Therefore, extrapolation of activity data from areas of good telemetry coverage to other parts of the home range is likely valid.

Both location and activity data sets suffer from autocorrelation (Swihart and Slade 1985). Samples are not independent from one another in either space or time. The degree of influence of non-independence of samples will be assessed in 1986 by comparing existing results with those calculated from a subset of the data that meet the criteria for independence as per Swihart and Slade (1985).

Conventional habitat evaluation often involves consideration of available area as well as animal use (Neu et al. 1974). The underlying assumption of this technique is that in the absence of active selection, habitats would be used in proportion to their availability (McLellan 1986). The seasonal use/availability test summaries given in Tables 11 and 12 for Shelly and Marsha, respectively, clearly show relative selection of ecosystem variations on a seasonal basis.

For Shelly, the MHd 01G, h306H (MCP overall reduced home range) and the h304F (season 7 MCP reduced home range) are the only coniferous forest units to show greater use than expected ($p<.1$). All of Shelly's dens were located in the MHd 01G, and thus explain its significance. The season 7 significance for the h304F appears to be an artifact of small sample size (1 location, 6 beardays).

For Marsha, four coniferous forest units show significantly greater use than expected: the i301G, h301G, h302G and the h306H (Table 12). While the i301G and h301G were used in the active seasons, the majority of beardays for these units were recorded in season 8. The season 7 significance for the h302G is likely a result of small sample size (1 location, 10 beardays).

Significantly greater use of the h306H than expected by both bears suggests that it has greater relative value than other coniferous forest units. Distribution of their activity records in this, the oldgrowth seral stage of the Floodplain spruce-devil's club association, were nearly even among bedding (33%), feeding (37%) and travel (27%) and demonstrate that a variety of life requisites are met in this habitat.

The test results shown in Table 13 of different measures of season 4 use and availability for Shelly indicate that the most conservative results were obtained from the combination of bear days and the 100% MCP home range. Logically, by including a large amount of unused area on the mountainsides into the home range (which 100% MCP does), the percentages of the total area of floodplain habitats drop. In this case, a lower percentage area of h306E3 (3%) when coupled with a large number of beardays (17 or 13%), results in significantly greater use than expected. The same habitat in the reduced MCP

Table 11. Seasonal use (bear days) of ecosystem variation and seral stage vs. availability for Shelly, 1982-1985

| Eco-System Unit | Home Range | | | | | | |
|---|---|---|---|---|---|---|---|
| | 96% Overall | Season 2 | Season 3 | Season 4 | Season 5 | Season 6 | Season 7 |
| H301E | | | G[a] | | | | |
| H301F | L | | | | | | |
| H301G | L | | | | | | |
| H3016I | L | | | | | | |
| H303F | L | | | | | | |
| H303G | L | | L | L | | | |
| H304F | L | L | | | | | G |
| H305F | | | | | | L | |
| H306B8 | G | | | | | G | |
| H306C8 | | | | L | | | |
| H306D5 | G | | | | G | | |
| H306D6 | | | | | | G | |
| H306D9 | | | | | G | L | |
| H306E1 | | L | | G | | L | G |
| H306E2 | G | | | G | | | |
| H306E3 | G | | | | | | |
| H306E4 | G | | | | | G | |
| H306H | G | | | | | | |
| H307E | G | | | | | | |
| H308G | G | | | | | | |
| I301A | | | G | | | | |
| I301F | L | | | | | | |
| I301G | L | | | | | | |
| D01G | G | G | | | | | |
| I308C | | | G | | | | |
| NONVEG | L | | | | | L | |

[a] "G" indicates significantly greater use than expected ($p<.1$).
"L" indicates significantly less use than expected ($p<.1$).
Only habitat units that have greater or less than expected use are listed.

Table 12. Seasonal use (bear days) of ecosystem variation and seral stage vs. availability for Marsha, 1982-1985

| Eco-System Unit | Home Range | | | | | | |
|---|---|---|---|---|---|---|---|
| | 96% Overall | Season 2 | Season 3 | Season 4 | Season 5 | Season 6 | Season 7 |
| H301CL | | | | | L[a] | | |
| H301G | | G | | | | G | |
| H301G1 | L | | | | | | |
| H302G | L | | | | | | G |
| H303F | L | | | | | | |
| H303G | L | | | | | L | |
| H304CL | L | | | | L | | |
| H304F | L | | | | | | |
| H305E1 | G | | | G | | | L |
| H305E4 | G | | | | G | | |
| H305G | L | | | | L | L | |
| H306B8 | | | | | | L | |
| H306C8 | | | | | L | | |
| H306D5 | G | | | | G | | |
| H306D9 | G | | | | | G | |
| H306E1 | | | L | G | | | |
| H306E3 | G | | | | G | | G |
| H306H | G | | | G | | | |
| I301G | G | | | | | | |
| I302G | L | | | | | | |
| I308A | | | G | | | | |
| I308C | | G | G | | | | |
| Estuary | | | G | | | | |
| NONVEG | L | L | L | | | | |

[a] "G" indicates significantly greater use than expected ($p<.1$).
"L" indicates significantly less use than expected ($p<.1$).
Only habitat units that have greater or less than expected use are listed.

outline accounts for 7% of the area and 14% of the use; the test results show no significant difference between them. The same argument applies to the difference between the MCP results and the reduced contour home range for h306E2. The contour method outlines a smaller home range area (827 ha) than the 100% MCP (3565 ha) and the reduced MCP (1245 ha). As a result, despite the beardays (14) and the overall availability of h306E2 being the same among the three home ranges (31 ha), it occupies a greater percentage of the total and results in no significant difference.

Differences among the three home range areas outlined also explain similar comparisons for Marsha (Table 14). Unlike Shelly's, Marsha's reduced MCP home range area is smaller than that from the contour method (878 vs. 1203 ha).

From comparison of analytical techniques (Tables 13 and 14) it appears that no single use or availabiltiy method best identifies seasonally important habitats. McLellan (1986) argues that the concept of comparing use and availability distributions is perhaps flawed, that, when bear familiarity with their home ranges is considered, "then what the animal uses is what it selects." Selection information for bear habitat units is summarized in Tables 15 to 19.

Shelly spent approximately 23% of her active season in potentially commercial forests (BHU's: Submesic, Sidehill and bench oldgrowth, and Floodplain climax and oldgrowth forests; Table 15 and Figure 3). If market demands for cottonwood increase (ie. cottonwood were to become commercial in the Mid-coast TSA), this figure would be considerably higher; a large proportion of the Floodplain seral BHU is mature cottonwood-dominated forest. Marsha spent 30.5% of her active season in potentially commercial forest (Table 16 and Figure 4).

Sample sizes for comparison of Shelly and Marsha's percent beardays with other intensively monitored bears are adequate for seasons 5 and 6 only (Table 17). As expected, all bears use the Floodplain seral forests heavily during the late summer and early fall (mean=52% for both seasons), reflecting the availability of salmon and late ripening berries in this BHU.

As was true for the ecosystem association and variation levels of the habitat classification, percent beardays summaries are insufficient to evaluate BHU's and should be considered together with available area (Tables 18 and 19). Using MCP reduced home ranges, significantly greater use than expected occurred five times in the three commercial BHU's: Floodplain oldgrowth- Shelly overall, Floodplain oldgrowth - Shelly season 5, Sidehill oldgrowth - Shelly season 7, Floodplain oldgrowth - Marsha season 4 and Sidehill oldgrowth - Marsha season 6. Of these, two are a result of small sample size: For Shelly season 7, one location (6 beardays - 4.1 ha), and for Marsha season 6, two locations (33 beardays - 40.1 ha) influenced the outcome of the Sidehill oldgrowth comparisons. Similar conclusions can be drawn about the Floodplain oldgrowth and climax forest BHU as were discussed for the h306H. Of the potentially commercial forested BHU's, it is the only one to be used in disproportion to its availability.

Table 13. Use vs. availability tests using different methods of home range area determination and ecosystem variation and seral stage use measurement for Shelly's season 4 home range

| Eco-System Unit | Frequency of location | | | Beardays | | |
|---|---|---|---|---|---|---|
| | 100% MCP | Reduced MCP | Reduced contour | 100% MCP | Reduced MCP | Reduced contour |
| DX05C[a] | L[b] | | | | | |
| H301G | | | L | L | | L |
| H303G | | L | L | | L | L |
| H306C8 | | | | | L | L |
| H306E1 | | | | G | G | G |
| H306E2 | | | | G | G | |
| H306E3 | | | | G | | |

a Mountain hemlock zone "d" subzone.
b "G" indicates significantly greater use than expected ($p<.1$).
"L" indicates significantly less use than expected ($p<.1$).
Only habitat units that have greater or less than expected use are listed.

Table 14. Use vs. availability tests using different methods of home range area determination and ecosystem variation and seral stage use measurement for Marsha's season 4 home range

| Eco-System Unit | Frequency of location | | | Beardays | | |
|---|---|---|---|---|---|---|
| | 100% MCP | Reduced MCP | Reduced contour | 100% MCP | Reduced MCP | Reduced contour |
| H305E1 | | | | G[a] | G | G |
| H305G | | | | | | L |
| H306E1 | | | | G | G | G |
| H306E3 | | | | G | | G |
| H306H | | | | G | G | G |
| I301G | L | | | L | | |
| NON VEG | | | | L | | |

a "G" indicates significantly greater use than expected ($p<.1$).
"L" indicates significantly less use than expected ($p<.1$).
Only habitat units that have greater or less than expected use are listed.

Table 15. Percent bear days by BHU for Shelly, 1982-1985

| Bear Habitat Unit (BHU) | Season | | | | | | | Active seasons only | All seasons |
|---|---|---|---|---|---|---|---|---|---|
| | 2 | 3 | 4 | 5 | 6 | 7 | 8 | | |
| Logged | | | 1 | 2 | | | | 0.5 | 0.5 |
| Subalpine forest | 45 | | | | | | 100 | 7.5 | 45.0 |
| Submesic forest[a] | 9 | 1 | 4 | 2 | | | | 3.0 | 2.0 |
| Estuary | | 7 | 1 | | | | | 1.5 | 1.0 |
| Sedge fens | 3 | 3 | | 2 | 1 | | | 1.5 | 1.0 |
| Floodplain seral forest | 3 | 4 | 51 | 57 | 69 | 72 | | 41.0 | 24.5 |
| Skunk cabbage swamps[a] | 4 | 2 | 3 | | 1 | | | 2.0 | 1.0 |
| Avalanche chutes | 4 | 59 | 10 | | 1 | | | 12.5 | 7.5 |
| Floodplain oldgrowth[a] | 14 | 4 | 16 | 22 | 10 | 8 | | 13.0 | 7.5 |
| Subalpine parkland | | 5 | | | | | | 1.0 | 0.5 |
| Floodplain seral non-forested | 3 | 2 | 7 | 15 | 17 | 5 | | 9.0 | 5.0 |
| Sidehill oldgrowth[a] | 15 | 12 | 7 | | | 15 | | 7.0 | 4.0 |
| Non-vegetated | | 1 | | | 1 | | | 0.5 | 0.5 |
| Days monitored | 122 | 120 | 132 | 146 | 152 | 41 | 483 | 713 | 1196 |

[a] potentially commercial (forested) BHU's.

Table 16. Percent bear days by BHU for Marsha, 1982-1985

| Bear Habitat Unit (BHU) | Season | | | | | | | Active seasons only | All seasons |
|---|---|---|---|---|---|---|---|---|---|
| | 2 | 3 | 4 | 5 | 6 | 7 | 8 | | |
| Logged | | | 5 | 9 | | | | 2.5 | 1.5 |
| Subalpine forest | | | | | | | 36 | | 14.0 |
| Dry shore pine | | | | | | 24 | | 1.5 | 1.0 |
| Submesic forest[a] | 31 | 12 | | 1 | 2 | 14 | 26 | 9.0 | 15.5 |
| Estuary | | 5 | | | | | | 1.0 | 0.5 |
| Sedge fens | 1 | | | 1 | 1 | | | 0.5 | 0.5 |
| Floodplain seral forest | 11 | 7 | 41 | 64 | 52 | 55 | | 36.0 | 22.0 |
| Skunk cabbage swamps[a] | 3 | 3 | 2 | | | | | 1.5 | 1.0 |
| Avalanche chutes | 21 | 56 | 18 | | | | | 18.5 | 11.0 |
| Floodplain oldgrowth[a] | | 2 | 20 | 13 | 8 | | | 8.5 | 5.0 |
| Subalpine parkland | | | 6 | | | | | 1.0 | 0.5 |
| Floodplain seral non-forested | | 3 | 2 | 9 | 15 | 7 | | 6.0 | 4.0 |
| Sidehill oldgrowth[a] | 32 | 8 | 5 | 3 | 22 | | 38 | 13.0 | 23.0 |
| Non-vegetated | 1 | 4 | 1 | | | | | 1.0 | 0.5 |
| Days monitored | 123 | 161 | 132 | 146 | 152 | 41 | 483 | 755 | 1238 |

[a] potentially commercial (forested) BHU's.

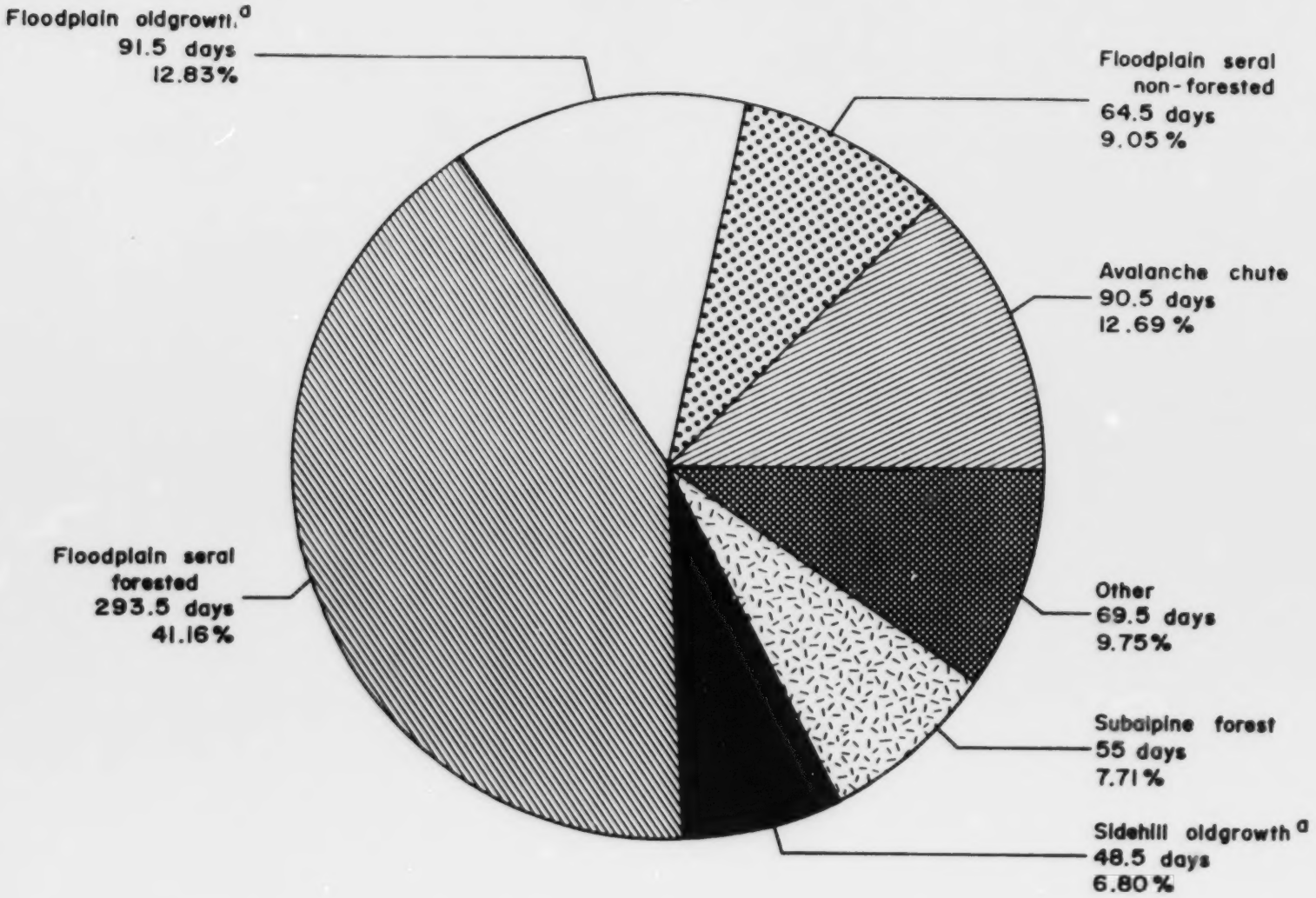



Figure 3. Shelly active season beardays by BHU, 1982 - 1985.

[a] Commercial forest BHUs

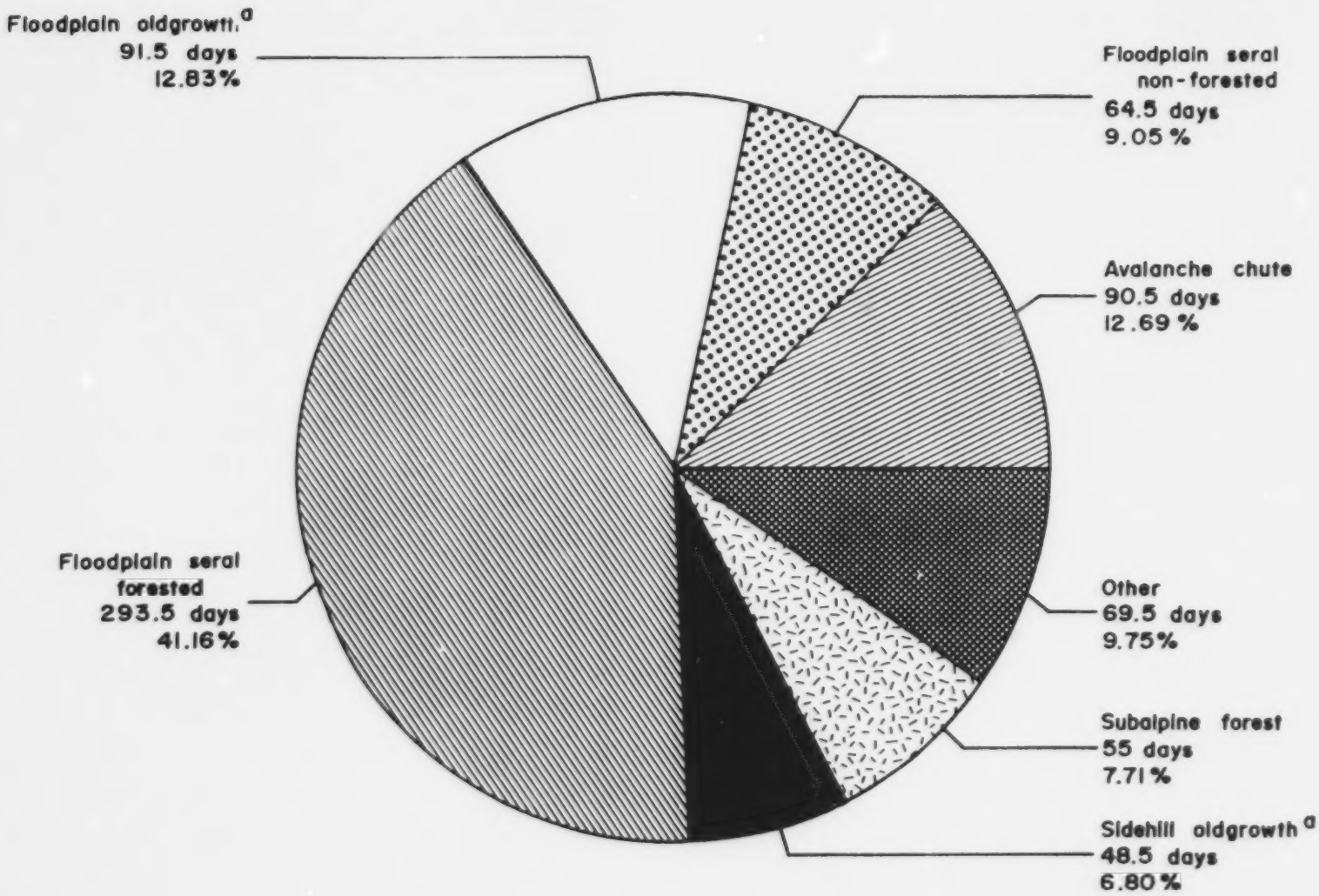



Figure 3. Shelly active season beardays by BHU, 1982 - 1985.

[a] Commercial forest BHUs

With the overall objective of evaluating the impact of forest practices on coastal grizzly bear habitat, methods were developed to relate habitat unit use and availability. The evaluation results summarized above are based on four assumptions we believe are valid: 1) intensively monitored grizzly bears were being adaptive at all times, i.e., doing what profits them most (Hamilton and Bunnell, in press), 2) time spent in an area is proportional to its value to an individual, 3) use of an area is a result of selection for the site and the resources therein rather than chance (McLellan 1986) and, 4) the intensively monitored grizzlies are representative of the population.

Whereas temporal patterns of selection were examined, spatial relationships of habitat units have not been addressed. The implicit assumptions have been that: 1) all occurrences of a habitat type have equal value, 2) use of a single unit is not related to the mosaic of other types around it, that is, the ecosystem type association or variation classified by seral stage is the level at which bears select habitat (juxtaposition), 3) the home ranges are homogeneous; the distances between all occurrences of a single type are uniform (interspersion), and 4) all habitats are available simultaneously (assumption 3, section 4.5.2.1).

To address such concerns adequately would take an experimental situation. High value units would have to be removed or alienated and the long term impacts on survivorship and fitness assessed. While empirical data lack the conclusiveness of experimental results, observed patterns, should, over time, lead to relative measures of habitat type value. Although these values do not translate into a specific number of bear-years, they do provide relative indices of value against which the potential impacts of forest development can be weighed. Each of the aforementioned assumptions will be tested in 1986, because of the critical nature of their influence on data presentation. An analysis of the risk of error associated with each to the validity of the management products will be conducted.

A preliminary attempt to investigate spatial patterns of habitat use in the lower Kimsquit is shown in Tables 20 and 21. The smallest seasonal average daily movement was recorded in season 6, when bears were feeding almost entirely on salmon (Table 20). For Shelly and Marsha, the season 7 and season three averages were similar, and rank next to season 6. Food resources in these three seasons were relatively area-concentrated. The influence of cubs on the mobility of the adult females is shown in Table 21. A significant increase in movement was noted for both bears between seasons 3 and 4 in 1983, as they split apart from their 2-1/2 year-olds. Similarly, Shelly's movement appeared to be restricted in 1985, by her one cub-of-the-year.

Table 17. Percent bear days by BHU for seasons 5 and 6 for Heath[redacted] and Brutus

| Bear habitat unit | Season 5 | | | Season | |
|---|---|---|---|---|---|
| | Heather | Henry | Brutus | Heather | Henr[redacted] |
| Submesic forest[a] | 0 | 0 | 9 | 0 | |
| Estuary | 0 | 0 | 0 | 0 | |
| Floodplain seral forest | 55 | 51 | 33 | 38 | 5[redacted] |
| Floodplain oldgrowth[a] | 5 | 12 | 2 | 3 | |
| Floodplain seral non-forested | 26 | 18 | 56 | 39 | 4[redacted] |
| Sidehill oldgrowth[a] | 14 | 19 | 0 | 20 | |

[a] potentially commercial (forested) BHU's.

Table 18. Seasonal BHU use (bear days) vs. availability for She[redacted]

| Bear Habitat Unit | MCP Reduced Home Ra[redacted] | | | | |
|---|---|---|---|---|---|
| | Overall | Season 2 | 3 | 4 | 5 |
| Logged | L[a] | | | L | |
| Subalpine forest | G | G | | | |
| Submesic forest[b] | L | L | L | L | L |
| Sedge fens | G | | | | |
| Floodplain seral forest | G | L | L | G | G |
| Skunk cabbage swamps[b] | G | | | | |
| Avalanche chutes | L | | G | | |
| Floodplain oldgrowth[b] | G | | | | G |
| Sidehill oldgrowth[b] | L | L | | | |
| Non-vegetated | L | | | | |

[a] "G" indicates significantly greater use than expected ($p<.1$).
"L" indicates significantly less use than expected ($p<.1$).
Only BHU's that have greater or less than expected use are lis[redacted]

[b] Potentially commercial (forested) BHU's.

Table 19. Seasonal BHU use (bear days) vs. availability for Marsha, 1982-1985

| Bear Habitat Unit | MCP Reduced Home Range | | | | | | |
|---|---|---|---|---|---|---|---|
| | Overall | Season 2 | 3 | 4 | 5 | 6 | 7 |
| Logged | | | | | L | | |
| Dry shore pine | L[a] | | | | | | G |
| Submesic forest[b] | L | | | | | L | |
| Estuary | | | G | | | | |
| Floodplain seral forest | G | | | G | G | G | G |
| Avalanche chutes | | G | G | | | | |
| Floodplain oldgrowth[b] | | | | G | | | |
| Floodplain seral non-forested | | | | L | L | | |
| Sidehill oldgrowth[b] | | | L | L | L | G | |
| Non-vegetated | L | L | L | | | | |

[a] "G" indicates significantly greater use than expected ($p<.1$).
"L" indicates significantly less use than expected ($p<.1$).
Only BHU's that have greater or less than expected use are listed.

[b] Potentially commercial (forested) BHU's.

Table 20. Seasonal average daily movement for Shelly and Marsha, 1982-1985 (m)

| Season | Bear | | | | |
|---|---|---|---|---|---|
| | Shelly | Marsha | Henry | Heather | Brutus |
| 2 | 610 | 933 | - | - | - |
| 3 | 401 | 573 | - | - | - |
| 4 | 1086 | 921 | - | - | - |
| 5 | 573 | 844 | 617 | 585 | 1078 |
| 6 | 349 | 481 | 585 | 607 | 854 |
| 7 | 505 | 463 | 1117 | 285 | - |

4.3.3.2 Bedding

Bedding has been recorded at 311 sites since 1983. Similar patterns of selection reported for 1984 (Archibald et al. 1985) were seen in 1985, including selection for cool shady sites in warm weather. Heavy use was observed in several traditional bedding areas. On 18 August, three collared bears were found in one of these sites just south of Pollard Creek. Brutus, Heather and Marsha were likely bedded down within 200 m of one another.

Bedding activity has been recorded across all seasons (Table 8). Sites in most seasons were characterized by relatively high cover of trees and low shrubs (Table 22). Season 2 was the exception with a low mean coverage of the low shrub strata and high coverage of the herb layer. For sites within security cover, percent cover of trees was highest in season 2 and lowest in season 7. Highest mean cover for the two shrub layers occurred in seasons 4 through 7 when bear activity was concentrated on the floodplain. There were no significant differences between seasons for strata coverage for sites in openings.

4.3.3.3 Feeding

While some differences in feeding behaviour were observed in 1985, data were similar to previous years. An increased reliance on Vaccinium spp. in August appeared related to above average fruit productivity, and reduced numbers of salmon, caused by low water levels. Collared grizzlies also fed more frequently in cutblocks, primarily on elderberry (Sambucus racemosa), raspberry (Rubus idaeus), and dogwood (Cornus sericea). A wide variety of food sources were available to grizzly bears in the Kimsquit (Table 23). No new food species were determined in 1985.

Eighty-one percent of 271 records of food species selection were collected in seasons 4 to 6 (Table 24). Like other frequency data, this sample suffered from lack of independence. However, such information is suitable for rank testing (Hamilton and Bunnell, in press) to identify significant differences between seasons and bears. A more complete treatment of diet, food plant nutrient analyses and phenology, and the role of forage in habitat selection will be found in Hamilton (in prep.).

Significant differences in mean cover between seasons at feeding sites were found only in the high and low shrub strata for sites in security cover (Table 25). Mean percent cover for high shrubs was greatest in season 6 and lowest in season 3. There were no feeding sites within security cover in season 7. Seasons 4 and 5 had the highest mean cover for the low shrub strata at sites in security cover. Feeding sites were characterized by low coverage of trees, high shrubs and moss and high coverage of low shrubs and herbs.

4.3.3.4 Marking

All known mark trees in the lower Kimsquit were re-visited in June and early July 1985 to meet the objective of documenting site characteristics and

Table 21. Annual summaries of seasonal daily movement averages for Shelly and Marsha, 1982-1985 (m)

| | 1982 | | 1983 | | 1984 | | 1985 | |
|---|---|---|---|---|---|---|---|---|
| Season | Shelly | Marsha | Shelly | Marsha | Shelly | Marsha | Shelly | Marsha |
| 2 | - | - | 851[a] | 475[a] | 675 | 1077 | - | 846 |
| 3 | 321[a] | 688[a] | 462[a] | 590[a] | 396 | 607 | 173[a] | 133 |
| 4 | 530[a] | 642[a] | 1309 | 1164 | 1312 | 670 | 745[a] | 744 |
| 5 | 74[a] | 102[a] | 519 | 1143 | 630 | 531 | 642[a] | 879 |
| 6 | 195[a] | 63[a] | 416 | 498 | 315 | 747 | 298[a] | 320 |
| 7 | 98[a] | 153[a] | 1009 | 801 | 385 | 229 | - | - |

[a] Accompanied by cubs.

Table 22. Mean percent cover of vegetative strata at bedding sites by season and security cover

| | | | Vegetative Strata | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Tree | | High Shrub | | Low Shrub | | Herb | | Moss | |
| Season | N[a] | N[b] | O[a] | C[b] | O | C | O | C | O | C | O | C |
| 2 | - | 10 | - | 58 | - | 8 | - | 23 | - | 41 | - | 51 |
| 3 | 3 | 7 | 35 | 41 | 1 | 8 | 4 | 25 | 7 | 22 | 2 | 40 |
| 4 | 1 | 21 | - | 44 | - | 18 | 20 | 59 | 5 | 28 | - | 11 |
| 5 | 4 | 67 | 4 | 55 | 32 | 19 | 10 | 47 | 21 | 20 | 23 | 14 |
| 6 | 20 | 74 | 14 | 41 | 11 | 17 | 10 | 49 | 13 | 19 | 12 | 19 |
| 7 | 1 | 9 | 35 | 32 | - | 24 | 55 | 43 | 5 | 14 | 30 | 22 |
| | | | | * | | * | | * | | | | * |

[a] Sites not in security cover.
[b] Sites in security cover.

*Significant differences between seasons ($p<0.05$)

Table 23. Verified grizzly foods in the Kimsquit valley, B.C., 1982-1985

| Scientific name | Common name | Parts consumed |
|---|---|---|
| **Plants** | | |
| *Angelica genuflexa* | White angelica | Roots, stems, and leaves |
| *Athyrium filix-femina* | Lady fern | Pinnae |
| *Carex sitchensis* | Sitka sedge | Blades |
| *Carex* spp. | Sedges | Blades |
| *Cicuta douglasii* | Water hemlock | Stems and leaves |
| *Cornus sericea* | Red-osier dogwood | Berries |
| *Equisetum* spp. | Horsetail | All? |
| *Heracleum sphondylium* | Cow parsnip | All |
| *Lonicera involucrata* | Black twinberry | Berries |
| *Lupinus nootkatensis* | Nootka lupine | Roots |
| *Lysichiton americanum* | Skunk cabbage | Roots (some leaves) |
| *Oplopanax horridus* | Devil's club | Leaf, stems, and berries |
| *Osmorhiza chilensis* | Mountain sweet-cicely | Roots |
| *Poaceae* | Grasses | Blades |
| *Ribes bracteosum* | Stink currant | Berries |
| *Rubus idaeus* | Red raspberry | Berries |
| *R. spectabilis* | Salmonberry | Shoots, leaves, and berries |
| *Sambucus racemosa* | Red elderberry | Berries |
| *Scirpus microcarpus* | Small-fruited bulrush | Blades |
| *Streptopus roseus* | Rosy twistedstalk | Berries |
| *Vaccinium* spp. | Blue and red huckleberries | Berries |
| *Veratrum viride* | Green false hellebore | Stems |
| *Viburnum edule* | Highbush cranberry | Berries |
| **Insects** | | |
| *Cedoptera* spp. | Beetle | Larvae |
| *Bombus* spp. | Honeybee | Larvae |
| **Fish** | | |
| *Oncorhynchus gorbuscha* | Pink salmon | All |
| *O. keta* | Chum salmon | All |
| *O. nerka* | Sockeye salmon | All |
| **Mammals** | | |
| *Alces alces* | Moose | Flesh |

Table 24. Seasonal frequency of use of food species for Shelly and Marsha based on site investigations, 1983 - 1985

| Food | Season | | | | | |
|---|---|---|---|---|---|---|
| | Two | Three | Four | Five | Six | Total |
| Angelica genuflexa | 0 | 3 | 0 | 1 | 0 | 4 |
| Athyrium filix-femina | 2 | 2 | 4 | 1 | 0 | 9 |
| Carex sitchensis | 1 | 0 | 1 | 0 | 0 | 2 |
| Cicuta douglasii | 0 | 1 | 1 | 0 | 0 | 2 |
| Cornus sericea | 0 | 0 | 0 | 5 | 0 | 5 |
| Equisetum spp. | 0 | 2 | 0 | 0 | 0 | 2 |
| Heracleum sphondylium | 0 | 4 | 6 | 0 | 0 | 10 |
| Insects | 1 | 0 | 2 | 1 | 1 | 5 |
| Lonicera involucrata | 0 | 3 | 6 | 0 | 0 | 9 |
| Lupinus nootkatensis | 0 | 0 | 0 | 0 | 1 | 1 |
| Lysichiton americanum | 7 | 6 | 2 | 2 | 6 | 23 |
| Oplopanax horridus | 3 | 2 | 35 | 4 | 0 | 44 |
| Osmorhiza chilensis | 0 | 0 | 4 | 4 | 1 | 9 |
| Poaceae (unknown grass) | 0 | 0 | 1 | 0 | 0 | 1 |
| Ribes bracteosum | 0 | 0 | 0 | 1 | 0 | 1 |
| Rubus idaeus | 0 | 0 | 1 | 7 | 0 | 8 |
| Rubus spectabilis | 3 | 3 | 9 | 0 | 0 | 15 |
| Salmon (fresh) | 0 | 0 | 0 | 22 | 33 | 45 |
| Salmon (rotten) | 0 | 0 | 0 | 0 | 17 | 0 |
| Sambucus racemosa | 0 | 0 | 23 | 10 | 0 | 33 |
| Scirpus microcarpus | 5 | 1 | 3 | 3 | 1 | 13 |
| Sedge (unknown spp.) | 3 | 0 | 0 | 0 | 0 | 3 |
| Vaccinium spp. | 0 | 0 | 5 | 4 | 0 | 9 |
| Viburnum edule | 0 | 0 | 0 | 1 | 0 | 1 |
| Total | 25 | 27 | 103 | 66 | 50 | 271[a] |

[a] Includes period when Shelly was accompanied by large male in June-July, 1983.

frequency of use (Archibald et al. 1985). Several sites that had not been catalogued before were also included in the sample. A total of 107 mark trees have been described at 88 sites.

Strata coverage sample sizes were small for marktree and marktrail sites (Tables 26 and 27). The only significant difference in mean coverage was in the tree strata at marktree sites in openings. While season 3 marktree sites appeared to have lower mean cover for the tree layer than the other seasons, data are inconclusive due to small sample sizes. Marktree sites had relatively high tree, herb and moss coverage and low coverage of the two shrub layers. The sample sizes for marktrail sites were too small to make any generalizations about differences in strata coverage.

Experimental removal of three mark trees, at three sites, was conducted to help identify the importance of marking and its relationship to feeding and travel activity (Archibald et al. 1985). At one of these sites, a new tree was heavily marked within 6 weeks of removal and an associated mark trail was re-established. At the other sites, no new marking was observed.

4.3.3.5 Travel

Most travel activity was recorded in openings (Table 28). There were no significant differences between seasons in any of the mean strata cover values. Travel sites tended to have low coverage of all strata at sites in openings and low coverage of trees, high shrubs and moss at sites in security cover.

4.3.3.6 Cover

The trends identified in preliminary analyses of the measures of security cover at grizzly bear activity sites discussed in Archibald et al. (1985) were supported by the inclusion of another year's field data and more detailed analyses.

Thirty-two percent of all site investigations were located in openings (Table 29). An additional 60% were within 100 m of an opening, suggesting that there were only a limited number of activity areas in the lower Kimsquit that did not have access to openings within 100 m. Sixty-eight percent of all site investigations were within security cover (Table 30) and an additional 9.3% were within 10 m of cover.

Security cover value summaries for all bears are provided in Tables 31 and 32. Security cover values varied seasonally. More of the site investigations were found in openings in the later seasons (5,6 and 7) than in the earlier seasons. Considering sites within cover only, significant differences were found between mean cover values stratified by season and primary activity (Table 33) (unbalanced ANOVA $p < .05$). There were no overall differences between mean cover for bedding, feeding and travel sites. Seasons two and seven had higher cover values than seasons five and six, which in turn were greater than seasons three and four.

Table 25. Mean percent cover of vegetative strata at feeding sites, by season and security cover.

| Season | N[a] | N[b] | Vegetative Strata: Tree O[a] | Tree C[b] | High Shrub O | High Shrub C | Low Shrub O | Low Shrub C | Herb O | Herb C | Moss O | Moss C |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2 | 1 | 6 | 2 | 23 | 10 | 10 | 2 | 43 | 5 | 61 | 10 | 37 |
| 3 | 2 | 13 | 5 | 14 | 3 | 4 | 10 | 30 | 82 | 35 | - | 11 |
| 4 | 6 | 35 | 30 | 29 | 6 | 16 | 39 | 56 | 40 | 35 | 9 | 15 |
| 5 | 18 | 14 | 11 | 28 | 10 | 19 | 17 | 53 | 23 | 26 | 4 | 11 |
| 6 | 12 | 11 | 6 | 32 | 3 | 30 | 18 | 33 | 16 | 27 | 4 | 12 |
| 7 | 1 | - | - | - | 5 | - | 5 | - | 5 | - | 10 | - |
| | | | | | | C | | C | | | | |

[a]Sites not in security cover.
[b]Sites in security cover.
[c]Significant differences between seasons ($p<.05$)

Table 26. Mean percent cover of vegetative strata at marktree sites, by season and security cover.

| Season | N[a] | N[b] | Vegetative Strata: Tree O[a] | Tree C[b] | High Shrub O | High Shrub C | Low Shrub O | Low Shrub C | Herb O | Herb C | Moss O | Moss C |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2 | 2 | 4 | 65 | 49 | 1 | 10 | 11 | 33 | 25 | 66 | 8 | 43 |
| 3 | 1 | 2 | 5 | 78 | - | 8 | 7 | 50 | 10 | 58 | 10 | 11 |
| 4 | 4 | 4 | 55 | 66 | 2 | 8 | 43 | 50 | 38 | 43 | 26 | 5 |
| 5 | - | 3 | - | 70 | - | 9 | - | 52 | - | 40 | - | 10 |
| 6 | 6 | 7 | 80 | 74 | 5 | 9 | 20 | 34 | 24 | 32 | 12 | 57 |
| 7 | - | 2 | - | 73 | - | 6 | - | 43 | - | 23 | - | 48 |
| | | | C | | | | | | | | | |

[a]Sites not in security cover.
[b]Sites in security cover.
[c]Significant differences between seasons ($p<.05$)

Table 27. Mean percent cover of vegetative strata at marktrail sites by season and security cover

| Season | N[a] | N[b] | Vegetative Strata: Tree C[a] | Tree C[b] | High Shrub O | High Shrub C | Low Shrub O | Low Shrub C | Herb O | Herb C | Moss O | Moss C |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2 | - | 1 | - | 40 | - | 5 | - | 20 | - | 85 | - | 20 |
| 3 | - | - | - | - | - | - | - | - | - | - | - | - |
| 4 | - | 1 | - | 25 | - | 1 | - | 10 | - | 25 | - | 15 |
| 5 | - | 3 | - | 45 | - | 8 | - | 35 | - | 20 | - | 22 |
| 6 | - | - | - | - | - | - | - | - | - | - | - | - |
| 7 | - | - | - | - | - | - | - | - | - | - | - | - |

[a]Sites not in security cover.
[b]Sites in security cover.

Table 28. Mean percent cover of vegetative strata at travel sites by season and security cover

| Season | N[a] | N[b] | Vegetative Strata: Tree O[a] | Tree C[b] | High Shrub O | High Shrub C | Low Shrub O | Low Shrub C | Herb O | Herb C | Moss O | Moss C |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2 | 4 | 2 | 1 | 30 | - | 8 | 8 | 40 | 6 | 68 | 1 | 35 |
| 3 | 2 | 1 | 33 | 25 | 3 | 5 | 13 | 75 | 5 | 40 | - | 2 |
| 4 | 14 | 5 | 2 | 24 | 4 | 7 | 11 | 53 | 11 | 17 | 2 | 10 |
| 5 | 21 | 1 | 6 | 20 | 2 | 25 | 8 | 35 | 9 | 10 | 6 | 5 |
| 6 | 22 | 2 | 6 | 50 | 6 | 15 | 13 | 45 | 12 | 45 | 3 | 20 |
| 7 | 4 | - | - | - | 4 | - | 9 | - | 8 | - | 9 | - |

[a]Sites not in security cover.
[b]Sites in security cover.

Table 29. Distance to opening (summary for all site investigations) for all bears, 1983-1985

| Distance to opening (m) | Frequency | % |
|---|---|---|
| 0 | 173 | 31.7 |
| 1-10 | 85 | 15.6 |
| 11-20 | 73 | 13.4 |
| 21-30 | 40 | 7.3 |
| 31-40 | 35 | 6.4 |
| 41-50 | 28 | 5.1 |
| 51-60 | 14 | 2.6 |
| 61-70 | 20 | 3.7 |
| 71-80 | 12 | 2.4 |
| 81-90 | 13 | 2.2 |
| 91-100 | 10 | 1.8 |
| 101-999 | 43 | 7.9 |
| TOTAL | 546 | |

Opening: arbitrarily defined as those sites where the total, in metres, of the horizontal visibility distance below 1 m above ground surface in the 4 cardinal directions from plot centre is greater than 100 m.
does not include "re-use" sites.

Table 30. Distance to security cover (summary for all site investigations)[a] for all bears, 1983-1985

| Distance to cover (m) | # of site investigations | % |
|---|---|---|
| 0 | 373 | 68.3 |
| 1-10 | 51 | 9.3 |
| 11-20 | 50 | 9.2 |
| 21-30 | 25 | 4.6 |
| 31-40 | 16 | 2.9 |
| 41-50 | 13 | 2.4 |
| 51-60 | 6 | 1.1 |
| 61-70 | 3 | 0.5 |
| 71-80 | 3 | 0.5 |
| 81-90 | 0 | 0.0 |
| 91-100 | 1 | 0.2 |
| 101-999 | 5 | 0.9 |
| TOTAL | 546 | |

[a] Does not include "re-use" sites.

Table 31. Security cover value by primary activity for all bears, 1983-1985[a]

| | Occurrence of activities by cover value classes | | | | Opening |
|---|---|---|---|---|---|
| Activity | 1-25m | 26-50 m | 51-75 m | 76-100m | Greater than 100 m |
| BEDDING | 42 | 101 | 58 | 30 | 35 |
| Row % | 15.9 | 38.1 | 21.9 | 11.3 | 13.2 |
| FEEDING | 33 | 39 | 21 | 5 | 44 |
| Row % | 23.2 | 27.5 | 14.8 | 3.5 | 31.0 |
| MARK TREE | 0 | 7 | 12 | 4 | 14 |
| Row % | 0.0 | 18.9 | 32.4 | 10.8 | 37.8 |
| MARK TRAIL | 0 | 0 | 3 | 2 | 4 |
| Row % | 0.0 | 0.0 | 33.3 | 22.8 | 44.4 |
| TRAVEL | 3 | 8 | 3 | 2 | 76 |
| Row % | 3.3 | 8.7 | 3.3 | 2.2 | 82.6 |

[a] Class scores are #'s of site investigations (N=546) not including "re-use" sites.

Table 32. Security cover value by season for all bears, 1983-1985[a]

| | Cover Class | | | | Opening |
|---|---|---|---|---|---|
| SEASON | 1-25m | 26-50 m | 51-75 m | 76-100m | Greater than 100 m |
| TWO | 0 | 6 | 12 | 5 | 8 |
| Row % | 0.0 | 19.4 | 38.7 | 16.1 | 25.8 |
| THREE | 13 | 5 | 3 | 2 | 9 |
| Row% | 40.6 | 15.6 | 9.87 | 6.2 | 28.1 |
| FOUR | 31 | 47 | 7 | 3 | 32 |
| Row % | 25.8 | 39.2 | 5.8 | 2.5 | 26.7 |
| FIVE | 23 | 45 | 36 | 13 | 49 |
| Row % | 13.9 | 27.1 | 21.7 | 7.8 | 29.5 |
| SIX | 11 | 50 | 35 | 15 | 69 |
| Row % | 6.1 | 27.8 | 19.4 | 8.3 | 38.3 |
| SEVEN | 0 | 2 | 4 | 5 | 6 |
| Row % | 0.0 | 11.8 | 23.5 | 29.4 | 35.3 |

[a] Class scores are #'s of site investigations (N=546) not including "re-use" sites.

Table 33. Mean cover value by season and primary activity from site investigations (N=373) of all bears in cover [a], 1983-1985

| Season | Primary Activity | | |
|---|---|---|---|
| | Bedding | Feeding | Travel |
| 2 | 60.6 | 60.8 | 34.5 |
| 3 | 21.0 | 16.9 | 39.0 |
| 4 | 31.4 | 26.6 | 41.3 |
| 5 | 45.6 | 43.4 | 76.5 |
| 6 | 48.4 | 58.8 | 29.7 |
| 7 | 71.6 | - | - |

[a] cover value 100m or less.

The implications of the analyses summarized above are dependent on the results of measuring the availability of cover in the study area and the test of security cover removal (section 5).

## 4.4 Impacts of Logging

### 4.4.1 Logging Activity

#### 4.4.1.1 Introduction and Hypotheses

Archibald et al. (1985) reported that two intensively monitored adult female grizzlies avoided the zone of hauling activity (zha) during hauling but that they moved back into this zone after logging had shut down. The behaviour of these bears was assumed to reflect that of wild grizzlies, unhabituated to human activity.

Other investigators have reported grizzlies avoiding areas of human activity (Harding and Nagy 1980; Tracey 1977; Zager and Jonkel 1983). However, we know that grizzlies will eventually habituate to activity and people. Unknown is what the cost of habituation is to grizzlies. Jope (1985) reported that back-country grizzlies in National Parks habituated to hikers and that this led to a reduction in the number of fear-induced full-charges by grizzlies in heavy use areas. However, any type of habituation outside of National Parks likely leads to a reduced survival probability because of increased vulnerability to legal or illegal hunting, and problem bear control.

The management objective of the Ministry of Environment is to maintain current numbers of grizzlies in coastal watersheds. Archibald et al. (1985) believe that this implies maintaining populations of bears unhabituated to human activity. Given the management relevance of this issue, disturbance monitoring was continued for 1985. The objectives for 1985 were:

1. to determine the width of the disturbance band
2. to determine if habituation to hauling was occurring
3. to complete disturbance analysis for all grizzlies.

We tested for habituation in two ways. The first way was the same as previous analyses and related to the location of grizzlies with respect to the zha during and not during hauling. The second way was to document changes in the width of the disturbance band, that is, the average distance from the road during hauling, over the field season.

Hypothesis 1

Grizzly bears will use the zha in the same fashion as in 1984, that is, avoid the zone during hauling ($p < .05$).

Hypothesis 2

The disturbance band width would not decrease over time ($p < .10$).

(Significance levels reflect the quality of data used to test each hypothesis - see section 4.4.1.2).

Hypothesis testing

1. Hypothesis 1 was tested by determining the verified locations of collared grizzlies in relationship to the zha.

2. Hypothesis 2 was tested by documenting the width of the zone alienated from grizzlies by logging truck traffic in seasons 4, 5 and 6 for Marsha and Shelly.

Rejection Criteria

Hypothesis 1 will be rejected if there is a change in the pattern of use of the zha, during and not during hauling between 1984 and 1985.

Hypothesis 2 will be rejected if the disturbance band width decreases over time.

4.4.1.2 Methods

Grizzlies in the intensive study area were monitored on a 24-h basis from July 17 to September 30, during seasons 4, 5 and 6. Site investigations were conducted on as many relocations as possible. These data were used to determine the relationship between grizzly location and activity and the zha.

The average distance between the road and each location was determined for Marsha and Shelly in seasons 4, 5 and 6 for 1984 and 1985. The data-set includes all verified and unverified locations in areas of reliable telemetry. The data for each bear were stratified into during and not during hauling for seasons 4, 5 and 6. Significant differences in distance from the road within seasons and years were sought during and not during hauling.

4.4.1.3 Results

Hypothesis 1

Hypothesis 1 was accepted for both bears. Between 1984 and 1985, there was no difference in the proportions of all locations in the zha, both during ($\chi^2 = .182$, $p = .6520$, $N = 93$) and not during ($\chi^2 = 2.010$, $p = .1529$, $N=156$) logging (Table 34).

Henry also appeared to avoid the zha during hauling (Table 35). Captured in 1984, this 5-year-old male was monitored while he was in the

Table 34. Verified locations of Marsha and Shelly with respect to the zone of hauling activity, during and not during logging

| Season | 1983[a] | | | | 1984 | | | | | | | | 1985 | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Not during logging | | | | Not during logging | | | | During logging | | | | Not during logging | | | | During logging | | | |
| | Shelly | | Marsha | | Shelly | | Marsha | | Shelly | | Marsha | | Shelly | | Marsha | | Shelly | | Marsha | |
| | In | out | In | out | In | out | In | out | In | out | In | out | In | out | In | out | In | out | In | out |
| 2 | 0 | 4 | 0 | 3 | 4 | 14 | 3 | 9 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 3 |
| 3 | 3 | 11 | 3 | 16 | 0 | 2 | 0 | 4 | 1 | 6 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 3 |
| 4 | 8 | 20 | 4 | 24 | 2 | 7 | 1 | 4 | 0 | 13 | 0 | 6 | 5 | 0 | 1 | 5 | 0 | 3 | 1 | 5 |
| 5 | 6 | 15 | 5 | 21 | 1 | 9 | 4 | 9 | 0 | 7 | 0 | 5 | 5 | 13 | 5 | 19 | 0 | 2 | 0 | 4 |
| 6 | 6 | 22 | 1 | 26 | 1 | 3 | 1 | 5 | 0 | 6 | 0 | 5 | 0 | 9 | 2 | 6 | 0 | 8 | 1 | 5 |
| 7 | 0 | 3 | 0 | 4 | 0 | 2 | 0 | 1 | 1 | 2 | 0 | 2 | | | | | | | | |
| Totals | 23 | 75 | 13 | 94 | 8 | 37 | 9 | 32 | 2 | 34 | 0 | 20 | 10 | 22 | 8 | 30 | 0 | 15 | 2 | 20 |
| In:out ratio | 1:3 | | 1:7 | | 1:5 | | 1:4 | | 1:17 | | 0:1 | | 1:2 | | 1:4 | | 0:1 | | 1:10 | |

[a] Includes 1982 aerial fixes.

Table 35. Verified locations of Henry with respect to the zone of hauling activity, during and not during logging for 1984 and 1985

| Season | not during logging | | during logging | |
|---|---|---|---|---|
| | in | out | in | out |
| 2 | - | 2 | - | 2 |
| 3 | - | - | - | - |
| 4 | 1 | 7 | - | 4 |
| 5 | 1 | 6 | 1 | 5 |
| 6 | 6 | 3 | - | 6 |
| 7 | - | 1 | - | 3 |
| Totals | 8 | 19 | 1 | 20 |
| in:out ratio | 1:2 | | 1:20 | |

$x^2 = 4.795$
$p = .0270$

intensive study area during 1984 and 1985. Pooled data for 1984 and 1985 on the locaton of Henry during and not during hauling showed the same pattern as for Marsha and Shelly ($\chi^2$ = 4.795, p = .0270, N=48).

Since distribution of locations was the same between years, it suggests that no habituation to zone activity has occurred. However, limited data suggest that habituation may be occurring for Marsha. Six of the last nine verified locations for her were either within the zha during hauling (2 in zone, Table 34), or just outside of the zha. This was the first time that any collared grizzly was consistently relocated near or within this zone during hauling. We did not observe a similar pattern for Shelly.

Observation of unknown grizzlies also suggests that the zone is used during hauling. The following seven observations were made:

1. 8/9/1984 at 0700: grizzly observed crossing road heading for cover after the first logging trucks of the day had passed.

2. 10/9/84: grizzly observed entering salmon channel after a logging truck went by, caught a salmon then took off immediately for cover with the fish.

3. 21/9/85: grizzly observed on road during hauling. No logging truck had been up the road for 80 min. The bear saw the telemetry vehicle, then walked back into the bush.

4. 11/9/1985: female grizzly with 2 yearling cubs approached salmon channel but before they could fish a logging truck was heard in the distance and they ran to cover before the truck appeared.

5. 11/9/1985: same family unit as above was observed feeding in zone during hauling. A pickup truck went by and no response was recorded from bears.

6. 12/9/1985: same family unit as above was observed feeding at salmon channel. An empty logging truck stopped and the driver observed the bears for a while. As the empty truck moved away it was observed by the family but the bears did not abandon the site.

7. 25/9/1985: same family unit as above observed travelling across the road 20 minutes after a logging truck had passed by.

These opportunistic observations may indicate individual variation in habituation response.

Hypothesis 2

Results of testing hypothesis 2 were mixed. There was a significant decrease in distance during hauling for Marsha in 1984, from season 4 to 5 (T=1.963, p=0.0794) (Table 36, Fig. 5). This leads to rejection of the hypothesis for Marsha. After this season there was no difference in distance from the road during hauling and no differenes were noted in 1985. Shelly showed no significant changes in distance to road over time until season 5 of

1985 (Table 36, Fig. 5). There was a significant increase in distance in this season ($T=-2.9218$, $p=0.0223$), then a significant decrease to season 6 ($T=2.2122$, $p=0.049$). Small sample size and her accompanying COY may have influenced the increase in mean distance in season 5.

There is limited support for disturbance hypothesis 1 in this data. Shelly's mean distance to the road during logging was significantly greater than not during logging in season 4 of 1984 ($T=-1.8725$, $p=0.0775$) and season 5 of 1985 ($T=-3.4158$, $p=0.0012$).

4.4.1.4 Discussion

Our data suggest that habituation may be occurring for our two intensively studied females. The mean distances from the road, during and not during hauling, within seasons showed a decreasing, though not statistically significant, trend (Table 36, Fig. 5). The initial response distance during hauling for both bears extended well beyond the effective range of the noise associated with hauling. However, after 1 season for Marsha and 2 seasons for Shelly there was no difference between the distances during and not during hauling.

Both bears continued to avoid the zha during hauling, although Marsha was beginning to show definite signs of habituation by the end of season 6 in 1985. However, the results from Marsha may be confounded by our security cover experiment at the Cornice site. A favoured salmon feeding site of Marsha's was manipulated and appeared to displace this bear to another salmon feeding site that was much closer to the road (see next section). A key question now is whether this apparent initial habituation will carry over into 1986.

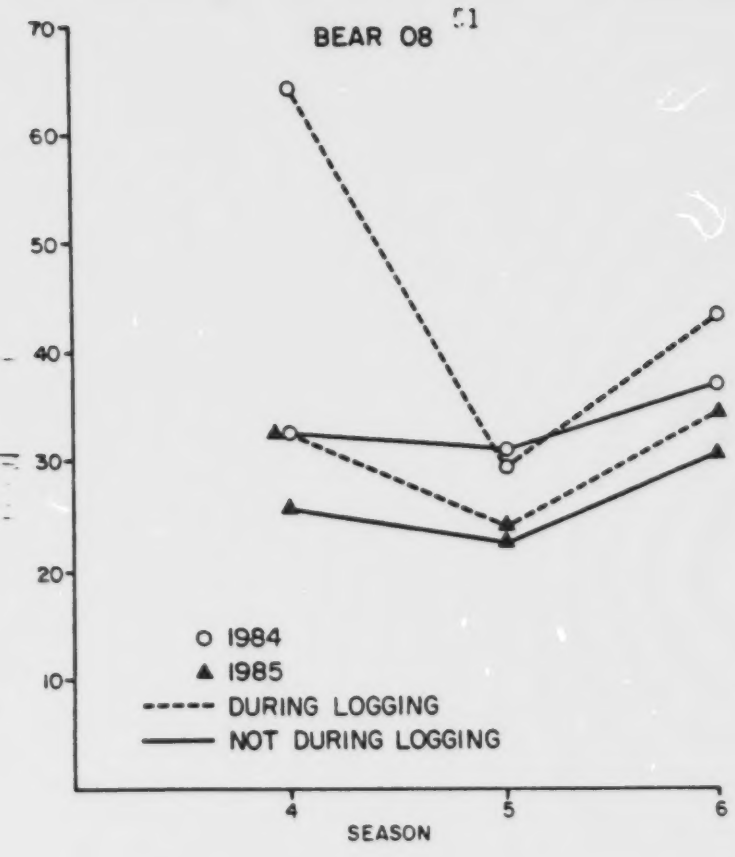
Shelly travelled with a cub-of-the-year in 1985 and there was no further manipulation of her home range. These two factors may account for no apparent habituation of this bear to the activity within the zha during hauling.

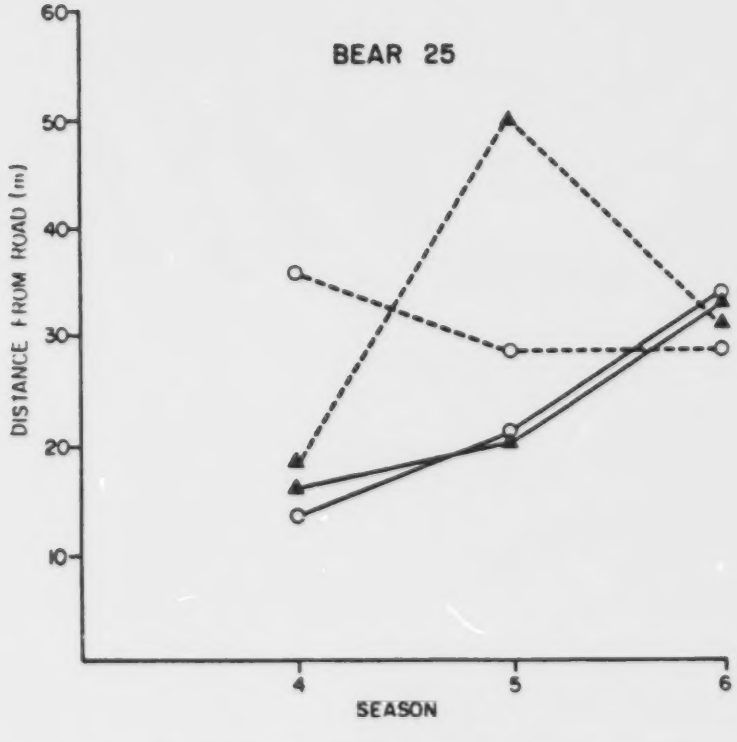
The limited information that we have on Henry reveals that this bear also avoided the zha during hauling. This indicates that sex/age classes other than adult females may show the same pattern of avoidance.

The observations of unknown grizzlies in the zha does not fit the pattern mentioned for collared grizzlies. However, these observations in the zha during hauling were made during seasons 5 and 6, the salmon seasons. We know that grizzlies come from long distances to fish for salmon in the Kimsquit (unpublished data). These unknown bears may have habituated to human activity elsewhere, or, the importance of feeding at this critical period may have outweighed the cost of avoiding human activity.

Table 36. Distance from road information (mean ± S.D.) for Marsha and Shelly, during and not during logging, in 1984 and 1985

| Season | 1984 | | | | 1985 | | | |
|---|---|---|---|---|---|---|---|---|
| | Marsha | | Shelly | | Marsha | | Shelly | |
| | not during | during | not during | during | not during | during | not during | during |
| 4 | 654.5 ± 345.8<br>n = 11 | 1288.9 ± 1023.9<br>n = 9 | 271.1 ± 170.3<br>n = 9 | 703.5 ± 922.9<br>n = 17 | 530.7 ± 133.1<br>n = 15 | 656.7 ± 377.2<br>n = 12 | 314.8 ± 210.2<br>n = 23 | 373.3 ± 329.8<br>n = 6 |
| 5 | 624.8 ± 413.4<br>n = 25 | 584.0 ± 249.2<br>n = 5 | 412.3 ± 148.6<br>n = 26 | 564.0 ± 406.5<br>n = 10 | 448.0 ± 313.5<br>n = 45 | 487.7 ± 320.2<br>n = 6 | 398.1 ± 296.4<br>n = 53 | 993.3 ± 208.2<br>n = 3 |
| 6 | 717.0 ± 262.5<br>n = 20 | 862.7 ± 353.0<br>n = 15 | 668.0 ± 297.3<br>n = 10 | 575.4 ± 307.5<br>n = 13 | 602.1 ± 269.5<br>n = 19 | 692.9 ± 419.6<br>n = 31 | 651.7 ± 253.6<br>n = 12 | 616.0 ± 269.1<br>n = 10 |




ure 5. Average distances from the road by season during and not during logging for Marsha (08) and Shelly (25).

[illegible] will be undertaken in 1986 to determine if Marsha continues [illegible] signs of habituation to the zha during logging and also to test for [illegible] ons of habituation for Shelly.

[illegible] Security cover removal

[illegible] Introduction and Hypotheses

[illegible] Gribaldi et al. (1985) reported that grizzlies preferred to be in cover [illegible] is in cover if the total of the sight distances at bear height (1 m) [illegible] four cardinal directions of a point is less than 100 m). It is [illegible] if bears are selecting for cover, or if the observed pattern of use [illegible] reflects the availability of openings in the study area (see 1986 [illegible] plan).

[illegible] help answer this question, we removed security cover adjacent to a [illegible] use site and monitored the response of grizzlies to this treatment. We [illegible] a salmon feeding site for this experiment because salmon feeding has [illegible] the most predictable grizzly activity and provided the best [illegible] data base.

[illegible] a typical year, salmon first become available to grizzlies near km 6 [illegible] mainline during late July. The feeding site consists of a [illegible] of recently established braided channels and consequently provides [illegible] cover. As salmon become available elsewhere, grizzlies [illegible] to select areas for feeding that have a high availability and [illegible] of salmon and associated security cover.

[illegible] experimental site was located near the mouth of Cornice Creek. In [illegible] sessions of 1982, 1983 and 1984 Marsha used the area extensively. [illegible] pre-treatment information was collected from both collared and [illegible] grizzlies.

[illegible] null hypothesis was that removal of security cover from a [illegible] will have no effect on grizzly bears' use of that area. [illegible]. This implies that:

- [illegible] would be no post-treatment change in the pattern and extent of [illegible] the removal area by the intensively monitored grizzlies.
- [illegible] would be no post-treatment shift of the intensively monitored [illegible] to a new salmon feeding area with adjacent security [illegible]

[illegible] Criteria

[illegible] will be rejected if:

- [illegible] is a 75% reduction in the number of times that Marsha uses the [illegible] area, compared to the pre-treatment data.

Hypothesis 2 will be rejected if:

1. Marsha shifts to another salmon feeding area that has adjacent security cover.

4.4.2.2 Methods

The experimental area was in the pole-sapling successional stage of the floodplain spruce-devil's club ecosystem association. Security cover was provided by alder, cottonwood and to a lesser extent by salmonberry and thimbleberry. Chum salmon availability and abundance was high during all years in the spawning channels within the experimental area. Pink salmon numbers were high during 1982 and 1984.

The experimental site was divided into removal and control areas. Initial brushing of the removal area was done in August, 1984 and it was cleaned up and expanded in 1985. The pole-sapling alder and cottonwood cover was removed from June 15 through July 10, and the remaining vegetation removed using a brush saw immediately before the onset of the first salmon season in late July. A bear anywhere in the removal area would be in an opening. The total size of the experimental area was five hectares; the removal area was one hectare.

The location of all collared grizzlies was determined on a 24-h basis during salmon seasons (5 and 6) using a truck-mounted telemetry system (Archibald et al. 1984). There were four sampling periods each day, two during logging and two after logging (see previous section). We attempted to conduct site investigations on all relocations within or close to the treatment area. Only verified locations were used for these analyses.

For direct observation a blind was established at the edge of the experimental area (Fig. 6). The blind, built on two topped spruce trees, was located 15 m from the ground. From it, an observer could view the entire removal area and much of the control area. When bears were observed the observer recorded the time of use, weather, bear behaviour and location. The observer was in radio contact with the telemetry vehicle and was kept informed of collared bear movement in the vicinity. A receiver was kept at the blind and was used only if a collared bear was in the immediate area but not observed.

Initially, the observer went into the blind before daybreak, stayed until mid-morning, returned late afternoon and left after dark. This pattern seemed to disrupt bear use of the area so we switched to entering the blind in late afternoon, observing while the light permitted, spending the night on the tower, then observing until mid-morning. The use of a night scope extended our viewing time during the twilight periods. The observation blind was used continuously from August 7 through September 30 except on August 12, September 20, 23, and 24.

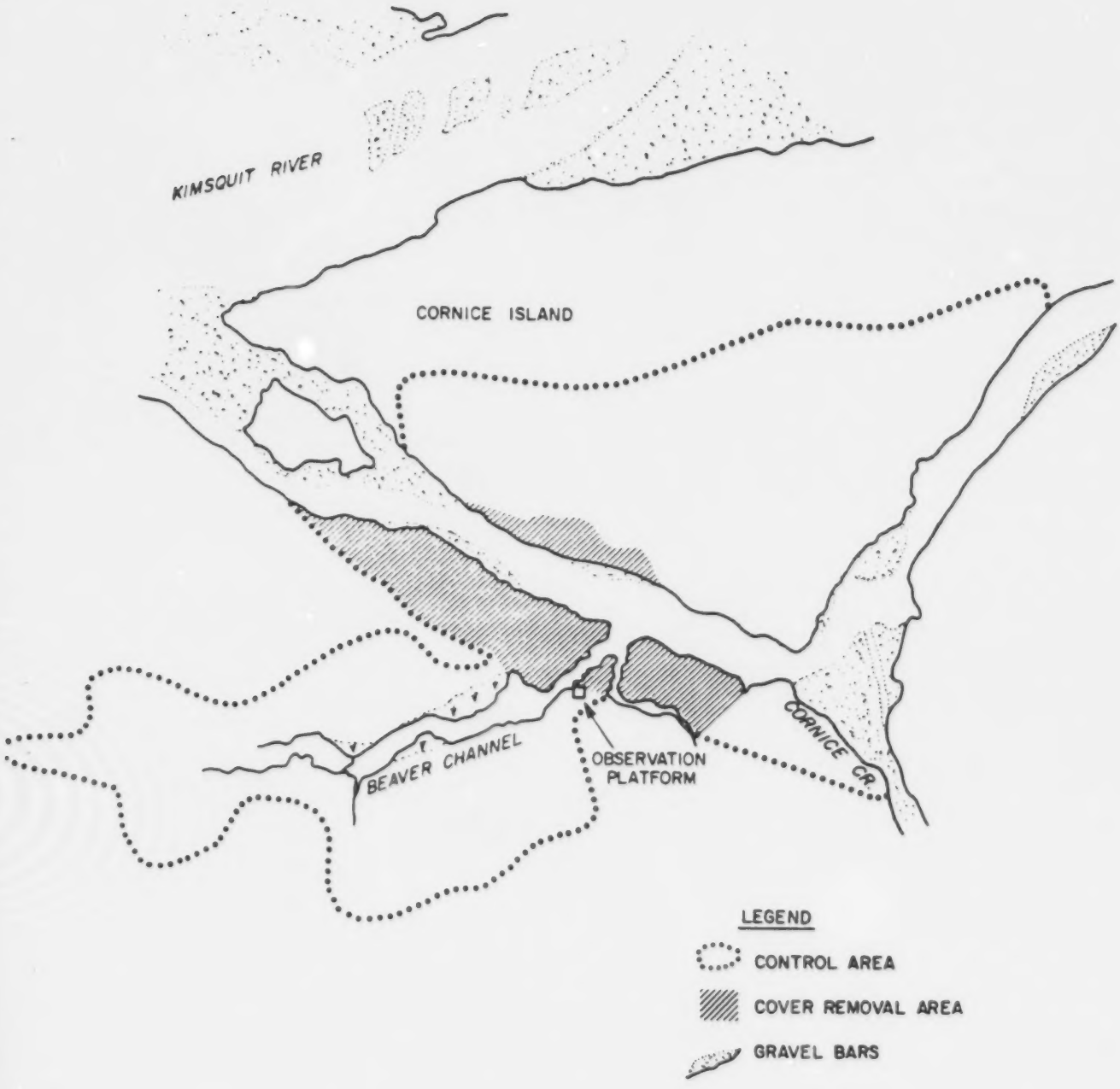



Figure 6. Cornice treatment area.

4.2.3 Results

Three hundred and twenty-three hours were spent observing the experimental area for bears. Forty-one bears were sighted: black bears 26 times, grizzlies 13 times, and 2 observations of unknown species. Black bears and grizzly bears were never seen on the experimental area at the same time, nor on the same day.

Grizzly bears were observed on the removal area five times. Two of these observations were during daylight. One was of an unknown grizzly that moved quickly and alertly across the area and the other was of an unknown large adult male grizzly that was fishing. The other three observations were after dark. One of these sightings was of an unknown grizzly that was believed to be marking on a mark trail previously found in the removal area.

Hypothesis 1 is rejected on the basis of information presented in Table 38. No locations were verified for Marsha in the removal area in 1985. As well, the number of bear days of use of the experimental area decreased from 29 in 1983/84 to 0.5 in 1985 (Table 38). Apparently, the removal of security cover from the treatment area also affected use of the control area.

The observational data from the tower supported these results. Marsha was observed from the tower three times (Table 37) and on all three occasions she was in the control area.

Seasonal home range data also supported a response to the treatment. For 1983 and 1984, the season 6 harmonic mean centres for Marsha were identical and centred near the experimental area. In 1985, her harmonic mean centre was located 3.8 km away.

Analysis of feeding site characteristics during seasons 5 and 6 for Marsha pre- and post-treatment reveals no difference in security cover ($\chi^2 = 1.253$, $p = .740$). This suggested that Marsha selected a new salmon feeding site that had the same security cover requirements provided by the removal area pre-treatment. Thus hypothesis 2 was rejected.

4.4.2.4 Discussion

The results of this experiment were confounded by small sample sizes, a drop in the abundance of salmon available to grizzlies in 1985 (an off year for pinks), the partial removal of cover in 1984, and the observer effect.

Despite these possible influences, we believe the displacement of Marsha was an effect of the experiment. This bear abandoned a site that she had used for the previous 3 years and fed on salmon elsewhere. These new feeding sites provided the same measure of security cover as the experimental area pre-treatment.

Table 37. Details of bear observations made from Cornice tower, August 7 - September 30, 1985

| bear | location | | activity | | | | Comments |
|---|---|---|---|---|---|---|---|
| | control | removal | travel | fish | bed | mark | |
| Marsha | 1 | | | X | | | |
| | 1 | | X | | | | |
| | 1 | | | X | | | |
| Henry | 1 | | X | | | | |
| unknown | 1 | | | X | | | |
| grizzly | 1 | | | X | | | |
| bears | 1 | | | X | | | |
| adult male(s) | 1 | | X | | | | |
| grizzly | 1 | | | X | | | |
| bears | 1 | | | X | | | |
| | 1 | | | X | | | |
| | | 1 | | X | | | after dark |
| | | 1 | | X | | | |
| unknown | 1 | | X | | | | |
| black | 1 | | | X | | | |
| bears | 1 | | X | | | | |
| | 1 | | X | | | | |
| | 1 | | | X | | | |
| | 1 | | | X | | | |
| | 1 | | | X | | | |
| | 1 | | X | | | | |
| | 1 | | X | | | | |
| | 1 | | X | | | | |
| | | 1 | X | | | | moved quickly |
| | | 1 | | | | X | after dark |
| known | | 1 | | X | | | after dark |
| black | 1 | | X | | | | |
| bears | 1 | | | X | | | |
| | 1 | | | X | | | |
| | 1 | | | X | | | |
| | 1 | | | X | | | |
| | 1 | | X | | | | |
| | 1 | | | X | | | |
| | 1 | | | X | | | |
| | 1 | | X | | | | |
| | 1 | | | | | | activity unknown |
| | | 1 | | X | | | |
| | | 1 | | X | | | |
| | | 1 | | X | | | nervous & alert |

Table 38. Use of security cover experiment area by Marsha pre- and post-treatment

| | Pre-treatment (83-84) | | Post-treatment (85) | |
|---|---|---|---|---|
| | removal | control | removal | control |
| # sites | 3 | 10 | 0 | 1 |
| # bear days | 9.5 | 19.5 | 0 | 0.5 |

Grizzlies were observed in the removal area either after dark or moving through with great haste. The only exception to this was the large adult male that moved through slowly and deliberately. This bear did not seem to be concerned about the lack of cover, perhaps suggesting that only adult male grizzlies are content to use the removal area during the daylight hours because of their dominant status. Others have reported that large adult males are dominant at salmon feeding sites (Meehan 1961; Stonorov and Stokes 1972) and that, at McNeil Falls, all sex/age classes of grizzlies feeding on salmon were wary of adult males (Egbert and Stokes 1976). This may help explain the importance of security cover to other sex/age classes of bears.

Two interpretations are possible to explain why grizzly use declined in both control and removal portions of the experimental site: (a) since use in both control and removal portions declined the causative factor was something else such as fewer salmon or observer effect, or both. That is, cover removal was not the factor that influenced bear use of the experimental site, or; (b) cover removal was the main factor influencing use, but its effect was on the entire experimental unit, both removal and control portions. That is, the experimental unit was too small - bears viewed it as one "unit", so change in one part reduced its overall suitability as a feeding site.

Given the supporting data from the home range analysis, and the security cover analysis, we favour a qualified acceptance of (b), qualified because of the confounding factors noted in the opening paragraph. This interpretation will be tested in 1986 (see Working Plan for details - Section 5.2.3).

### 4.4.3 Effects of defoliant herbicide application on berry productivity

Application of the defoliant herbicide Roundup (Montsano Corp.) on 30 ha in cutblock 2 was delayed by weather for one year from August 1984 to August 1985. Roundup was applied using backpack sprayers from August 20 to August 22, 1985. Prior to herbicide application the 50 permanent berry plots in cutblock 2 were visited twice to monitor berry abundance, species ground coverage and phenology in June and July 1985 (see Archibald et al. 1985: 42-43). Seven new plots were established in a proposed treatment area of cutblock 6 and berry productivity was also assessed at these. All records have been coded and keypunched but not yet analyzed. Bear use of the treatment area of cutblock 2 prior to application was given high priority in both 1984 and 1985. A significant increase in the number of verified site investigations in cutblock 2 for Shelly and Marsha occurred in 1985 prior to application.

## 4.5 Management Products

Three levels of management products are planned to transfer the results of the coastal grizzly project to management. These products will be hierarchical, although each could stand on its own, and are aimed at the scales of management activity where the needs and values of tools appear the greatest.

The highest level product will be a ranked list of watersheds in each MOF timber supply area (TSA). Ranking will be on the basis of their importance to coastal grizzly management as viewed by the Ministry of Environment. Rankings will be based on a combination of biological and management criteria.

The second product will be a model that will enable planners to consider bear habitat value at a watershed planning level of 1:20 000. This model would be used for watersheds identified in product 1 as having high priority for grizzlies.

The final product will be a user's guide that will describe coastal grizzly seasonal habitat requirements and high use areas. It will provide an array of logging prescription options for maintaining grizzly habitat value in and near high use areas.

All three products listed above will be designed for easy use. Their ease of application will be a function of the attitudes of the target user groups, rather than product sophistication. Those working in the forest sector must be convinced that safeguards are needed for maintaining grizzly habitat value. Employees within MOE need to recognize the role that foresters and others within the industry can play in maintaining grizzly habitat value.

4.5.1 Level 1 Product: A Strategic Planning Guide for Grizzly Bears in Coastal British Columbia.

This product is currently under development. Biological criteria for ranking coastal watersheds have been identified based on the Kimsquit project. A similar list of management criteria are being developed by Wildlife Programme staff. These two sets of criteria will be combined by a formula that will be used to rank all major coastal watersheds for grizzlies. This product should be completed by July 31, 1986, in time to be applied in the current re-analysis of some coastal TSA's.

4.5.2 Level 2 Product: Coastal Grizzly Habitat Model

This model will attempt to quantify the relationships between coastal grizzlies and their habitat.

We have been working concurrently on two levels of coastal grizzly habitat models: a research model or Habitat Suitability Index Model (HSI) and a management model or rate of cut model. Since the HSI model is used in the management product both are discussed below.

4.5.2.1 HSI model for coastal grizzlies

We continued to develop the HSI model discussed in the 1984 Progress Report (Archibald et al. 1985). This model reflects our current

understanding of the relationship between coastal grizzlies and their habitat.

## Life requisites

Included in this model are the life requisites of food, security cover and thermal cover (hot and inclement weather bedding).

## Assumptions

1. There is a direct linear relationship between the HSI and carrying capacity.

2. This model is based on wild, undisturbed and unhunted grizzlies.

3. Given the small home ranges of coastal grizzlies, the mobility of the species, and the physiography of coastal watersheds, all habitat types are available to grizzlies simultaneously.

4. The observed seasonal pattern of use for each BHU is proportional to its suitability value.

5. Adult female grizzlies are the most sensitive and important component of coastal grizzly populations. An HSI model built for this sex/age class will meet the requirements of all other sex/age classes.

6. The life requisites of water, reproduction and denning have no specific requirements in coastal valleys, or meeting these requirements will not be a problem unless there is a return to historic logging practices that resulted in tidewater to mountain-top clear cuts.

## Geographic Area

This model was based on data and experience from the intensive study area of the Kimsquit River valley. It will be applied to the entire coast if validated by synoptic surveys.

## Seasons

This model evaluates the habitats used by grizzlies during the period from den emergence to den entrance (seasons 1 through 7 inclusive, Table 7).

## Bear Habitat Units (BHU's)

Table 5 outlines a preliminary list of BHU's and details their relationships to the Kimsquit ecological (ecosystematic) and forest cover units. These units can be identified on 1:20 000 air photos and relate to seasonal grizzly habitat selection observed in the lower Kimsquit.

Model Building

Strategy:

Relative food values from 0-1 were assigned for each BHU for all active seasons (Table 39), where: 0 equals no value, .25 equals low value, .50 equals medium value, .75 equals high value and 1.0 equals highest value. For each BHU we assigned values that represent our collective "best judgement" of values. Once data analyses are completed, assigned values will be based on the abundance of seasonally preferred foods as determined by scat analysis and feeding site investigations.

Seasonal weightings were assigned based on the availability and abundance of preferred bear food among seasons. Highest weighting (10) was for seasons 1 and 7 when bears have the fewest feeding options. The lowest weighting was for season 5 when there is an abundance of food available. Weightings for other seasons were relative to the above two categories.

The annual food value for each BHU is also outlined in Table 39. This was calculated for each BHU by summing the weighted seasonal food values. Notice that the highest values are those that provide a source of food during seasons when grizzlies have the fewest feeding options (seasons 1, 2 and 7).

Seasonal security cover values were assigned for each BHU using the same ranking system and are presented in Table 40. These assigned values were based on the estimated relative availability of security cover within each BHU.

Seasonal weightings for security cover were based on the seasonal importance of security cover as reflected by our grizzly use data. The highest weighting was for season 4(3) and the lowest for seasons 6 and 3(1). Weighted seasonal values were used to calculate annual security cover values. These are also presented in Table 40. The units with the highest annual security cover values are the floodplain seral forested (10.5), floodplain oldgrowth (10.5) and the sidehill oldgrowth/bench (9.8) (Table 40).

Seasonal and annual relative thermal cover values are presented in Table 41. These values may reflect the availability of either cover from inclement weather (conifers) or cover from hot weather (deciduous cover or availability of snow pack). No weightings were applied to seasonal values because we believe that this requisite is equally important across all seasons (see Section 4.3.3.2).

Seasonal and annual relative quality values for each BHU are outlined in Table 42. Seasonal quality values were calculated by adding together the seasonal values for food, security cover and thermal cover using the following weighting: 10:3:1 for food:security cover:thermal cover. (Note: Using this technique it is only legitimate to compare values within seasons).

Table 39. Seasonal and annual food values for each BHU

| BHU | Season value (seasonal weighting) | | | | | | | Annual Value[a] |
|---|---|---|---|---|---|---|---|---|
| | 1(10) | 2(5) | 3(2.5) | 4(1.5) | 5(1) | 6(1.5) | 7(10) | |
| FS | | 0 | | | 1.0 | .75 | .25 | 4.6 |
| FF | | .25 | | 1.0 | 1.0 | 1.0 | .25 | 7.8 |
| SO | | | | .5 | .5 | | | 1.3 |
| FO | | .25 | | 1.0 | 1.0 | 1.0 | .25 | 7.8 |
| SA | | | .25 | | | | | .6 |
| SF | .75 | 1.0 | .25 | | | | | 13.1 |
| SS | .25 | 1.0 | .25 | | | | .5 | 13.1 |
| AC | | .25 | 1.0 | .25 | | | | 4.1 |
| PL | | | | | | | | |
| MH | | | | | | | | |
| SM | | | | .25 | | | | |
| EY | 1.0 | .75 | .5 | .5 | .25 | .25 | | 16.4 |
| LG | | | | .75 | .25 | | | 1.4 |

[a] Annual value = $\sum_{1}^{7}$ weighted seasonal values

Table 40. Seasonal and annual security cover values for each BHU

| BHU | Season value (seasonal weighting) | | | | | | | Annual Value[a] |
|---|---|---|---|---|---|---|---|---|
| | 1(1.5) | 2(1.5) | 3(1) | 4(3) | 5(2.5) | 6(1) | 7(1.5) | |
| FS | | 0 | .25 | .25 | .25 | .25 | 0 | 1.9 |
| FF | | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 10.5 |
| SO | | .5 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 9.8 |
| FO | | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 10.5 |
| SA | | | .25 | .25 | .25 | .25 | | 1.9 |
| SF | | | | | | | | 0 |
| SS | | .25 | .25 | .25 | .25 | .25 | .25 | 2.6 |
| AC | | | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 9.0 |
| PL | | | | | | | | 0 |
| MH | | | .5 | .5 | .5 | .5 | .5 | 4.5 |
| SM | | .25 | .25 | .25 | .25 | .25 | .25 | 2.6 |
| EY | | .25 | .25 | .25 | .25 | .25 | .25 | 2.6 |
| LG | | .25 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 9.4 |

[a]Annual value = $\sum_{1}^{7}$ weighted seasonal values

Table 41. Seasonal and annual thermal cover values for each BHU

| BHU | Season value | | | | | | | Annual Value[a] |
|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | |
| FS | | | | | | | | |
| FF | | | .75 | 1.0 | 1.0 | 1.0 | | 3.8 |
| SO | | .25 | .75 | | | | .25 | 1.3 |
| FO | .25 | 1.0 | .75 | 1.0 | 1.0 | 1.0 | 1.0 | 6.0 |
| SA | | | 1.0 | | 1.0 | 1.0 | | 3.0 |
| SF | | | | | | | | |
| SS | | | | | | | | |
| AC | | | 1.0 | .25 | .25 | | | 1.5 |
| PL | .5 | 1.0 | | | | | 1.0 | 2.5 |
| MH | | | .5 | .25 | .25 | .25 | .25 | 1.5 |
| SM | .5 | 1.0 | | | | | 1.0 | 2.5 |
| EY | | .25 | .25 | .25 | .25 | .25 | | 1.3 |
| LG | | | | | | | | |

[a]Annual value = $\sum_{1}^{7}$ weighted seasonal values

Annual quality values for each BHU were calculated by combining the annual BHU values for food, security cover and thermal cover in the same manner. Note: From Table 42 that the units that have the highest value are the estuary (EY), skunk cabbage sites (SS) and sedge meadow areas (SF).

Model Limitations

The objective of the HSI process is to assign a habitat value to a watershed that reflects its carrying capacity for grizzlies.

This would allow us to compare carrying capacity between and among watersheds. Perhaps more importantly, this process would allow us to assess the impacts of logging in a watershed by calculating changes in HSI values as logging changes the number, frequency, and area of BHU's.

However, this process has the following shortcomings:

1. We believe that the measures we make of the life requisites explain approximately 50 percent of the variability of each one. Errors can be attributed to the following factors:

   a. There is no allowance at this level for unit size, the amount of edge or unit juxtaposition.

   b. Many important habitat elements are not specific to any particular habitat unit.

2. We believe that habitat diversity (numbers, types and areas of habitats) is as important as the life requisites in determining the carrying capacity for a watershed. We are still exploring ways of measuring habitat diversity.

3. We require an estimate of the total number and amount of BHU's required for a grizzly to meet requirements. These thresholds would allow us to calculate an overall habitat quality value that must be maintained if the capability of the watershed to support grizzlies is to be maintained. We have been unsuccessful in calculating BHU thresholds.

4. Forest cover inventory information along the coast is poor. As well, the relationship between forest cover and BHU's appears poor. Rules will be further refined in 1986 with the addition of slope, aspect and elevation data.

5. Many of the most important elements of coastal grizzly habitat cannot be mapped at an operational scale.

These problems are not insurmountable. Weaver et al. (1986) have developed a measure of habitat diversity for grizzly habitat in Yellowstone National Park that can be adopted and refined for coastal B.C.. Inventory

Table 42. Seasonal and annual relative quality values for each BHU

| BHU | Seasonal value[a] | | | | | | | Annual Value[b] |
|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | |
| FS | | | 1 | 1 | 11 | 8 | 3 | 52 |
| FF | | 6 | 4 | 14 | 14 | 14 | 6 | 113 |
| SO | | 2 | 4 | 8 | 8 | 3 | 3 | 44 |
| FO | | 7 | 4 | 14 | 14 | 14 | 7 | 116 |
| SA | | | 4 | 1 | 2 | 2 | | 15 |
| SF | 1 | 10 | 3 | | | | | 131 |
| SS | 3 | 11 | 3 | 1 | 1 | 1 | 6 | 139 |
| AC | | 3 | 14 | 6 | 3 | 3 | 3 | 70 |
| PL | 1 | 1 | | | | | 1 | 3 |
| MH | | | 2 | 2 | 1 | 2 | 2 | 15 |
| SM | 1 | 2 | 1 | 3 | 1 | 1 | 2 | 14 |
| EY | 10 | 9 | 6 | 6 | 4 | 4 | 1 | 173 |
| LG | | 1 | 3 | 11 | 6 | 3 | 3 | 42 |

[a]Seasonal value = 10(seasonal food value) + 3(seasonal security cover value) + seasonal thermal cover value

[b]Annual value = 10(annual food value) +3 (annual security cover value) + annual thermal cover value

Table 43. Annual MCP home range sizes ($km^2$) and % overlap for Marsha and Shelly

| Bear | 100% annual H.R. | Reduced annual H.R.[a] | % overlap |
|---|---|---|---|
| Marsha | 85.5 | 30.4 | 29 |
| Shelly | 59.6 | 25.3 | 35 |
| $\bar{X}$ | 72.6 | 27.8 | 32 |

[a]inflection point home range. For Marsha = 89% HR, for Shelly = 96% HR.

information will improve, and grizzly habitat elements that cannot be mapped can be addressed at the prescription level (level 3 product). The most serious limitation has been our failure to develop thresholds. A proposed method of addressing this problem is presented in the next section.

As a research tool the HSI model has proved invaluable. However, we feel that it is inappropriate as a management tool because of the number and complexity of the calculations that would be required. To meet the needs of management we have collapsed the HSI model into the following rate of cut model.

4.5.2.2 Rate of cut model for coastal grizzlies.

We believe that rate of cut is the most important potential impact of logging on coastal grizzlies. Logging has the potential to reduce habitat diversity, a key element of grizzly bear habitat capability (Weaver et al. 1986). We feel it imperative that grizzly habitat value be included at the watershed planning level. The objective is to develop a product that will enable planners to assess the impacts of rate of cut on coastal grizzlies. For this model to be successful it must be easy to use and relate to existing inventory information.

Model components

1. Bear habitat units (BHU's): as described in Table 5.

2. Reach length: coastal grizzly activity is concentrated on river floodplains during the active season. Logging/grizzly interactions are most pronounced in floodplain habitats since they also contain the most accessible and valuable timber. A reach length is the area required by an adult female grizzly to meet requirements. Each reach length is centred on the floodplain and extends laterally to mountain tops on both sides of the river. This model will be run on a reach length basis.

   Reach length for the lower Kimsquit is 10 km and was calculated by subtracting the average percentage overlap from the average reduced MCP home range (Table 43) dividing the resultant area by the average mid-slope valley width (2 km). Reach lengths are contiguous.

   Reach lengths will vary within and between watersheds depending on the number, frequency, size and juxtaposition of BHU's. Information from other coastal grizzly research projects can be compared to those from the Kimsquit in an attempt to quantify the relationship among these factors.

3. Thresholds: we require estimates of the minimum BHU area per reach length to ensure that sufficient resources are left after logging or produced by forest activities for female grizzlies to meet requirements. As mentioned in the above section (HSI) we have not

yet been successful in calculating thresholds. However, we have developed the following strategy for estimating thresholds.

1. Identify the seasonally important BHU's (from Table 42).

2. Predict the impacts of logging these BHU's on grizzly habitat capability by means of a workshop with forest ecologists and grizzly bear biologists.

3. Use the results of 2 to decide which BHU's must be incorporated in rate of cut analysis (those BHU's where logging will have a significant impact on grizzly habitat capability), and which can be addressed in a prescription handbook (user's guide).

4. Estimate thresholds in a workshop. These estimated thresholds become hypotheses to be tested with existing data and during synoptic work.

This process is outlined in more detail in Appendix C.

Model application:

Steps:

1. The appropriate reach length for the watershed under consideration will be selected from a table provided.

2. The watershed will then be blocked into a number of contiguous units based on reach length.

3. The number of occurrences and areas of each BHU within each reach length will be tabulated.

4. A proposed rate of cut for the watershed will be calculated that ensures minimum BHU thresholds for each unit will be maintained. Several scenarios that reflect timber accessibility and proposed 5-year development plans will be suggested, each with a bear management preference.

Model limitations

This model also has its limitations. The most important of these are outlined below.

1. We have attempted to derive thresholds from habitat use data collected in the Kimsquit. Results were inconclusive.

2. We have spent some time reviewing and participating in watershed planning exercises. We wonder if this type of product fits with current logging practices.

3. We know that some bears can compensate for the loss of habitat by substituting from other elements of their home range. These synergystic interactions among BHU's should be quantified to adequately address logging impacts on grizzlies.

4. The model does not address the problem of habituation of bears to logging activity and people. We expect that there is a relationship between rate of cut and probability of grizzly habituation to people or traffic, and consequent shooting mortality. We need to explore this relationship and include it in the model, if appropriate.

Despite the problems outlined above, we still believe there is merit in proceeding with the development of a rate of cut model because of the importance of incorporating bear habitat values at the watershed planning level. We feel confident that we can build such a model based on our experience and best judgement of the requirements of bears. This model can be used as a hypothesis, and, more importantly, can be transferred to management as an adaptive management tool - something that can be refined over time.

### 4.5.3 Level 3 Product - A User's Guide for the Management of Coastal Grizzly Bear Habitat

Figure 7 presents an outline of the potential logging impacts on coastal grizzlies and presents prescriptions. Following is a table of contents of the user's guide as it is currently envisaged. This product will be a pocket-sized, loose-leaf guide.

Table of Contents — No. of Pages


1.0 Introduction — 1

2.0 Seasonal Definitions — 2

3.0 Bear Habitat Units (BHU's) — 2

4.0 Seasonal Habitat Use Patterns (graphics) — 4

5.0 Overview of Logging Impacts and Prescription Options — 1

6.0 Prescriptions For High Use Areas
- 6.1 Feeding — 3
  - 6.1.1 Requirements
  - 6.1.2 Identifications (graphics)
  - 6.1.3 Prescriptions
- 6.2 Bedding — 4
  - 6.2.1 Hot Weather
    - 6.2.1.1 Requirements
    - 6.2.1.2 Identifications (graphics)

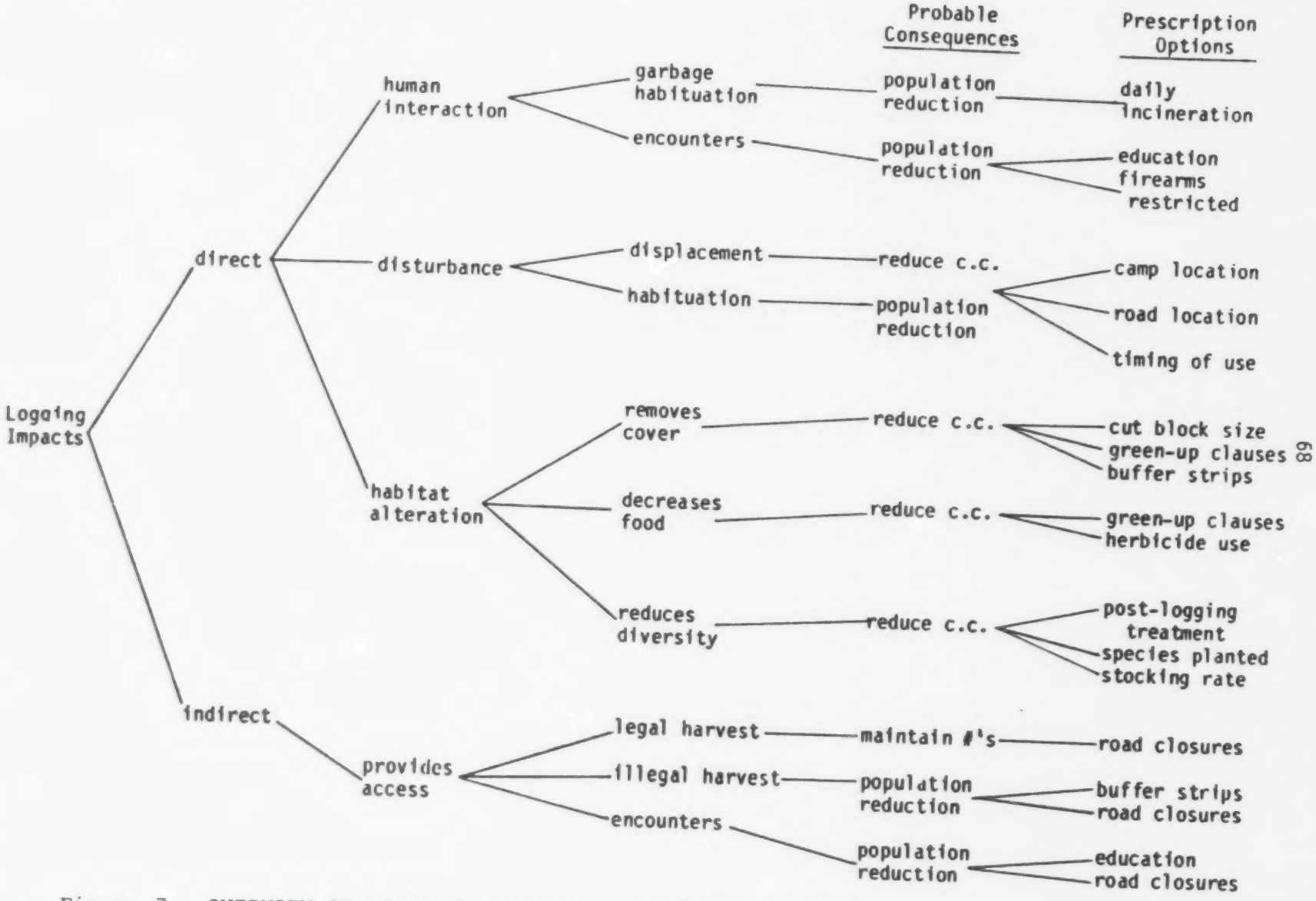



Figure 7. OVERVIEW OF LOGGING IMPACTS AND PRESCRIPTION OPTIONS.

6.2.1.3 Prescriptions
6.2.2 Inclemerc Weather
6.2.2.1 Requirements
6.2.2.2 Identifications (graphics)
6.2.2.3 Prescriptions
6.3 Marking 2
6.3.1 Requirements
6.3.2 Identifications
6.3.3 Prescriptions

7.0 Prescription Details (graphics) 4

User's guide verification:

Some prescription options for maintaining grizzly habitat value will be based on preliminary synoptic work conducted in 1986 (see 1986 Working Plan - Section 5.3).

Objectives include addressing the following questions:

1) Do the seasonal definitions developed for the Kimsquit apply elsewhere on the coast?

2) Do grizzlies exhibit the same seasonal movement patterns elsewhere on the coast as those observed in the Kimsquit (when and where do bears move)?

3) Are the within season patterns of habitat selection elsewhere on the coast similar to those observed in the Kimsquit?

4.5.4 Technology Transfer

Technology transfer will occur during the development and field verification steps for both management tools through working committees of user groups set up in the spring of 1986. Committee members were drawn from MOE, MOF, and industry and were selected on the basis of their interests, skills and responsibilities. These committees will ensure management relevance of the products and help facilitate general acceptance of these products. Once product development and verification is complete, technology transfer will proceed as follows.

Rate of cut model:

Delivery of the model to planners within government and industry will be accomplished during a number of demonstration workshops. Former committee members will play a key role in this exercise.

User's guide:

Training for proper use of the user's guide will be more difficult because it will involve a much larger client group and will require field

demonstration. Former committee members will also play key roles in product 3 delivery. Options for delivery include establishing a demonstration watershed for training in proper guide use or providing trained personnel to work on site with users. The mode of product delivery will be addressed by the product committee.

## 5.0 WORKING PLAN

The following plan outlines objectives, field work locations and methods, and an analysis and reporting schedule for 1986. Previous working plans are: Archibald and Hamilton (1983), Hamilton and Archibald (1984) and Archibald et al. (1985).

### 5.1 Field Objectives

Objectives for the field season are divided into those for the lower Kimsquit and those for other watersheds.

#### 5.1.1 Lower Kimsquit

1) to continue with the assessment of security cover importance to grizzly bears at high value feeding sites

2) to continue monitoring the effect of logging truck traffic on collared grizzly bear movement and activity

3) to monitor the effects of the 1985 application of a defoliant herbicide on berry productivity and bear use of cutblocks

4) to determine the availability of security cover in the intensive study area to compare against the use pattern observed from 1983-1986

5) to continue to assess the importance of grizzly bear marking behaviour.

#### 5.1.2 Other watersheds

1) to assess the applicability of the Kimsquit research results to other coastal watersheds. Specifically, to confirm the current understanding and determine the geographic variability of:

a) BHU definition (numbers, ecological relevance)

b) general seasonal habitat selection patterns

c) season definition (timing, order, duration)

d) habitat selection criteria (habitat elements)

2) to assess the impact(s) of selected forest practices on grizzly bear habitat capability (food and cover value) in a variety of sites, including:

a) Yarding method

b) Site treatment

c) Restocking method

d) Conifer release

e) Stand tending

5.2 Field methods - Lower Kimsquit

5.2.1 Security cover experiment

Our preliminary results indicated that the removal of security cover from a high use feeding site resulted in the abandonment of this site. These results were confounded by small sample sizes, a reduction in the abundance of preferred food (an off year for pink salmon), and the partial removal of cover in 1984. Our objective for 1986 is to try to confirm the findings of 1985.

The forest management application of this experiment is discussed in the 1985 Working Plan (Archibald et al. 1985).

Pink salmon will be abundant in 1986. This will allow us to eliminate the most serious confounding factor of 1985. We will again remove all security cover from the removal area and monitor grizzly use of this area.

The general null hypothesis is that there will be no change in the manner in which grizzlies use the experimental area between 1985 and 1986. Specifically, this implies that:

1. There will be no shift by Marsha back to the experimental area in 1986.

2. There will be no increase in the total amount of grizzly use of the removal area in 1986.

Hypothesis testing - Methods and Measures

i) The removal area established in 1985 will be brushed immediately prior to the onset of season 5 (the first salmon season).

ii) The location of collared grizzlies will be determined as often as possible during seasons 5 and 6. Site investigations will be conducted on all relocations in the experimental area.

iii) If telemetry data suggest that Marsha, or any other collared grizzly, is regularly using the experimental area an observer will be placed in the tree blind.

iv) The experimental area will be visited bi-weekly to monitor grizzly use. All records of grizzly activity will be recorded.

Rejection Criteria

Hypothesis 1 will be rejected if:

i) Marsha uses the removal area at all in 1986.

Hypothesis 2 will be rejected if:

i) There is any regular use of the removal area by any sex/age class except adult males.

Confounding Factors

i) Marsha may be accompanied by cubs-of-the-year (coys) in 1986. If so she may avoid the experimental area because of her cubs rather than as a result of the treatment. However, if she uses the removal area while accompanied by coys, our conclusions from 1985 will be voided.

5.2.2 Effects of Logging Truck Traffic

Results to 1985 suggest that neither adult female has habituated to the zha during hauling, although Marsha was beginning to show preliminary signs of habituation.

The potential impacts of both avoidance and habituation of grizzly bears to logging truck traffic are discussed in the 1985 Working Plan (Archibald et al. 1985).

The proposed strategy for 1986 has two objectives:

1. To determine if Marsha has become habituated to hauling activity, and;
2. to determine if Shelly continues to avoid the zha during hauling.

Methods of data collection are outlined in Archibald et al. (1985). The hypothesis is that:

i) There will be no change in how Marsha or Shelly use the zha during and post-hauling.

Hypothesis testing

The location of Marsha and Shelly will be determined during seasons 4, 5 and 6 as time and manpower permit. Site investigations will be conducted on all relocations near or within the zone.

Rejection Criteria

i) The hypothesis will be rejected if there is a significant difference ($\alpha < .10$) in how Marsha and Shelly use the zha during hauling.

Confounding Factors

i) Marsha may be accompanied by coys in 1986. If so, she may avoid the zha because of them. However, if she continues to use the zha with coys this will be strong evidence for habituation of this bear.

5.2.3 Security cover availability

Security cover measurements were recorded at all activity investigation sites, and results from the intensive study area suggest that security cover is an important criterion of habitat selection (see Tables 29 and 30, section 4.2.3.5). Although the distribution of openings in the study area appears to be uniform, bears appear to be selecting for areas with higher security cover values. However, there has not been adequate evidence to suggest that within a home range, habitats selected have a higher cover value than what is generally available. Nor has it been shown that within a habitat type, sites selected have higher cover values than the mean for that habitat. Therefore, the 1986 field research will include a program designed to estimate cover availability.

The application of results of investigations into the importance of security cover are discussed in Archibald et al. (1985).

Sampling will be conducted within two home ranges (overall reduced MCP) of Marsha and Shelly. Each home range will have a pre-determined number of potential sampling points regularly distributed within its boundary. Cover values and habitat types will be recorded at randomly selected points, thereby providing a representative sample of cover values within the home range and within habitat types. The distribution of cover value measurements over the five cover value categories (see Table 31) will be compared with results of site investigation to determine differences between cover use and cover availability within a home range. The 'availability' distribution can also be compared to distributions of observed site cover values within each activity (bedding, feeding, etc). to evaluate importance of cover density to particular behaviours. Similarly, cover availability within a habitat type can be compared to observed cover values from site investigations in that habitat type to determine if cover is selected, avoided, or used in proportion to its availability.

The general null hypothesis is that there will be no difference between the proportions of grizzly bear use sites assigned to specific cover classes and the proportions determined from sample points at the home range or habitat level. In other words, the distribution of observations from site investigations among the cover classes is the same as the distribution of

observations from the random sample. This will also be tested within activity categories (i.e., five tests, one each for bedding, feeding, etc.). This hypothesis will also be tested within habitat type - a test for each habitat type with adequate numbers of site and random samples.

Hypothesis testing - Methods, measures and analyses

Between 1 July and 15 August (seasons 4 and 5) approximately two man-months field effort will be devoted to determining security cover availability.

Shelly and Marsha's overall reduced MCP home range outlines will be traced onto a 1:20 000 map of the intensive study area gridded at 200 m intervals. Cover value will be measured at grid intersections; therefore, there are 600-750 sample points in each home range. This grid size will be logistically feasible and provide enough sample points to be representative of the home range but not too many should sampling effort be reduced by unforeseen events. Lines of the grid will be sequentially numbered so that each grid intersection is individually labelled. Initially one intersection point (the starting point) and one grid direction (N, S, E, W) will be randomly chosen. Security cover measurements will be recorded at the starting point and adjacent intersection points in the specified direction along the grid. If subsequent points are outside the home range boundary, the direction of movement will be perpendicular to the original direction (randomly chosen, of course). No grid point will be sampled more than once.

This random selection scheme will be repeated for three days, following which the samplers will decide how many points are feasible to measure in one day (e.g. 20). The remaining points on the grid (those not yet measured) will be divided into pattern blocks that include the feasible number of points, and each pattern block will be numbered. Subsequent points to be sampled will be randomly selected as a block. In this way all points will be part of one block or another, and potential logistic and navigational problems associated with scattered, unsampled points will be eliminated. This sampling scheme will provide a random selection of cover value measurements within the home range and within available habitat types; the resultant distribution of records in the five cover classes will be representative of cover available in the home range and available within a habitat type.

Chi-square two-way contingency tables will be used to test for significant differences between distributions of cover measurements at activity sites and random sites. Tests will be performed for each hypothesis described. Loglinear analysis, a multi-way contingency table analysis, may be used to investigate interactions of activity, cover density, and habitat type.

Rejection Criteria

If significant differences are found in the distributions of cover measurements among the five cover classes at activity sites and random sites, the null hypotheses will be rejected.

Confounding factors

1) Cover availability will be assessed in two seasons only. Existing data suggest that the differences among seasons in mean cover value (sites in cover only) are partly a function of seasonal changes in cover availability.

2) Cover measurements in habitat types that are a small proportion of the total home range area will be fewer than habitats covering more of the study area. If a particular habitat is extremely limited in the study area the sample size of cover measurements may be too small for valid statistical testing of the 'habitat' hypothesis. Empty cells in a contingency table or low expected values, both results of insufficient sample size, invalidate the chi-square test. Lumping of cell frequencies, if biologically meaningful, can overcome this problem in some cases.

5.2.4 Cutblock food production and grizzly use after herbicide application

The application to forestry, methods, and confounding factors of this investigation are discussed in Archibald et al. (1985). Efforts in 1986 will include careful comparison of berry abundance data in the "control" or buffer area among years to help remove the influence of annual differences in productivity.

5.2.5 Marking behaviour

Attempts to determine the importance of marking behaviour and the potential impacts of forestry on it are discussed in Archibald et al. (1985). Mark tree removal sites will be monitored on a weekly basis to determine whether or not new trees are marked.

5.3 Field Methods - Other Watersheds - Pilot Synoptic Sampling

Successful extrapolation of research from the intensive Kimsquit study area to elsewhere in coastal British Columbia will depend on evaluation of the applicability of results in several "synoptic" watersheds. The synoptic field work has three purposes: 1) to test the coastal grizzly bear habitat models for their potential management applicability, 2) to assess how much variance there is in bear habitats and habitat use patterns along the coast and 3) to assess the impacts of a wide variety of forest practices on bear habitat capability. The third objective is necessary because Kimsquit study animals have access to only a limited number of logged areas, the oldest of which is five years. As most major coastal watersheds have already been

developed, such information is critical to assessing the impacts of forestry.

### 5.3.1 Strategy

In 1986, pilot synoptic work will be conducted to assess and refine field techniques to be used in 1987. Confirmation of coastal grizzly bear habitats and habitat use will be sought in three watersheds: the upper Kimsquit, Kitimat (Wedeene), and Khutzeymateen rivers. Verification of bear use of seasonally important habitats will be determined by site visitation to high use feeding and bedding areas. Without the luxury of radio collars, unit importance will be assessed subjectively along sample transects. High use areas will be predicted on the basis of the HSI model developed for the intensive Kimsquit study area (section 4.5.2.1). If predictions are erroneous, alternate habitats will be visited and grizzly bear use investigated. The variability in bear habitat definition on the north and south coasts will be compared with topographical and ecological characteristics of those determined for the mid-coast (Table 5). New crosswalk tables of forest cover and ecological units will be prepared in advance using the existing forest cover and ecological information (Haeussler et al. 1984; Klinka et al. 1984) and their validity tested along sample transects. New habitats will be sampled and described if necessary, and the appropriate ties made to forest cover and ecological classification.

Assessment of the mid and long term impacts of a variety of logging, site treatment, restocking, conifer release, and stand tending methods on coastal grizzly habitats and use will occur in the Kitimat (Wedeene) river in 1986. Efforts will be primarily directed towards alluvial ecosystems because of their obvious importance to bears, but also because of their accessibility (economic and physical) for timber harvest. The road and logging costs of valley bottom development are lower than for sidehill units. Floodplain commercial timber stands are also comparatively lower in area but higher in volume/area ratio. Specific site history information will be obtained and field effort allocated on the basis of the perceived degree of impact on habitat capability of the different practices (Table 44). Different watersheds will provide information required in different matrix cells (Table 45). Capability will be assessed by transect and plot sampling (cover and food productivity). Careful record of species composition, stand structure, canopy closure, and conifer regeneration will be kept to relate back to site history information.

Table 4. Matrix of logging prescriptions and bear habitat units
- Mature commercial timber types only.
Matrix score indicates degree of potential influence on grizzly bear habitat capability (high, medium or low).

| Forest practice | | | Bear habitat unit | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Subalpine forest | | | | Sidehill oldgrowth | | | | Floodplain deciduous forest[2] | | | | Floodplain oldgrowth | | | |
| | | | Number of years since logging | | | | | | | | | | | | | | | |
| | | | 0-5 | 6-15 | 16-30 | 31+ | 0-5 | 6-15 | 16-30 | 31+ | 0-5 | 6-15 | 16-30 | 31+ | 0-5 | 6-15 | 16-30 | 31+ |
| Timber harvest (yarding) | yarding method | high lead | H | L-M | 6 | 6 | H | L-M | 6 | 6 | M[5] | M? | 6 | 6 | M[5] | M? | 6 | 6 |
| | | grapple | H | L-M | 6 | 6 | H | L-M | 6 | 6 | H | M[4] | 6 | 6 | H | M[4] | 6 | 6 |
| | | access | N/A | N/A | N/A | N/A | L+ | L+ | 6 | 6 | H | L-M[4] | 6 | 6 | H | L-M[4] | 6 | 6 |
| | | cat | N/A | N/A | N/A | N/A | L+ | L+ | 6 | 6 | H | L-M[4] | 6 | 6 | H | L-M[4] | 6 | 6 |
| | | skidder | N/A | N/A | N/A | N/A | ? | ? | 6 | 6 | H | L-M[4] | 6 | 6 | H | L-M[4] | 6 | 6 |
| Site treatment[3] | | spot burn | L | 6 | 6 | 6 | L | 6 | 6 | 6 | L | L | 6 | 6 | L | L | 6 | 6 |
| | | light broadcast | L | M+ | L+ | 6 | L | M+ | L+ | 6 | L | L | 6 | 6 | L | L | 6 | 6 |
| | | med. broadcast | M? | M? | L? | L? | M? | M? | L? | L? | L-M | L-M | 6 | 6 | L-M | L-M | 6 | 6 |
| | | hot broadcast | H | H | H | M | H | H | H | M | H | M | 6 | 6 | H | M | 6 | 6 |
| Restocking | planting | numerous combinations of stock type, stock density, distribution & species | 6 | 6 | 6 | 6 | 6 | 6 | L | 6 | L | M | M[7] | M[7] | L | M | M[7] | M[7] |
| | natural regeneration | numerous combinations of stand density, distribution & species | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | L | L | M[7] | M[7] | L | L | M[7] | M[7] |
| Conifer release (brush & weed) | mechanical | | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | L-M | L-M | L-M | 6 | L-M | L-M | L-M | 6 |
| | chemical | 2,4 - D | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | M | M | M | 6 | M | M | M | 6 |
| | | Roundup | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | H | H | H | F | H | H | H | 6 |
| Stand tending | thinning and spacing | | 6 | 6 | 6 | 6 | N/A | N/A | 6 | 6 | N/A | N/A | M[8] | H | N/A | N/A | M[8] | H |
| | pruning | | 6 | 6 | 6 | 6 | N/A | N/A | 6 | 6 | N/A | N/A | M[8] | M | N/A | N/A | M[8] | M |
| | fertilization | | 6 | 6 | 6 | 6 | N/A | N/A | L+ | L+ | N/A | N/A | L+ | L+ | N/A | N/A | L+ | L+ |

[1] Assumptions about commercial viability include consideration of current market conditions and economic accessibility (e.g. no skylines in MH zone).

[2] Included because of increasing market demand for cottonwood - does not include post-logging regeneration or second growth.

[3] Mechanical site treatment not included - not widespread practice.

[4] Dependent on degree of silt removal.

[5] Assumption that high lead logging occurs in floodplain forests.

[6] Potential impact is nil or relatively low.

[7] Assumption that no stand tending occurs, scores would drop one level with stand tending.

[8] Dependent on degree of debris removal.

L low

M medium

H high

+ indicates potential beneficial impact.

Table 45. Matrix of logging prescriptions and bear habitat units - Mature commercial timber types only.[a] Matrix contents show which synoptic watershed will provide data to assess prescription impact on grizzly bear habitat capability

| Forest practice | | | Bear habitat unit | | | |
|---|---|---|---|---|---|---|
| | | | Submesic forest | Sidehill oldgrowth | Floodplain seral forest[b] | Floodplain oldgrowth |
| Timber harvest (yarding) | yarding method | high lead | Toba | Toba | | |
| | | grapple | Toba | Toba | | |
| | | access | | | | |
| | | cat | | | | Lower Kimsquit |
| | | skidder | | | | |
| Site treatment[c] | | spot burning | | | | |
| | | light broadcast | | | | |
| | | med. broadcast | | | | |
| | | hot broadcast | Toba | Toba | | |
| Restocking | planting | numerous combinations of stock type, stock density, distribution & species | Toba? | Toba | | |
| | natural regeneration | numerous combinations of stand density, distribution & species | Toba | Toba | | |
| conifer release (brush & weed) | mechanical | | | | | |
| | chemical | 2,4-D | | | | |
| | | Roundup | | | | Kimsquit |
| Stand tending | thinning | | | | | |
| | pruning | | | | | |
| | fertilization | | | | | |

[a] Assumptions about commercial viability include consideration of current market conditions and economic assessibility (e.g. no skylines in MH zone).

[b] Included because of increasing market demand for cottonwood - does not include post-logging regeneration or second growth.

[c] Mechanical site treatment not included - not widespread practice.

## 6.0 PROJECT COMPLETION PLAN

Planning for the coastal grizzly project began in 1981. Field work began in April 1982 and four field seasons of intensive data collection have been completed.

The project is now entering the next phase: management product development and verification, and technical product preparation. We expect that this phase of the project will be completed by March 31, 1988.

The final phase of this project will be management product transfer. It will commence in 1987/1988 and extend into 1988/1989. Table 46 details the completion plan timetable. Field work in 1986 and 1987 will be focussed on field verification of the User's Guide (see details of 1986 working plan). Project staff levels should maintain their current status, and the present funding level should also be maintained, until the end of fiscal 1987/1988.

Beyond the end of fiscal 1987/1988 project activities will focus on transferring the products to management and monitoring the success of these products. This monitoring loop will likely result in products being refined. One FTE should be assigned this responsibility for 1988/1989. Other project costs should be minimal.

Section 6.1 outlines the Table of Contents for the coastal grizzly monograph. We have decided that the final project report will be in monograph format and published as a Branch Technical Monograph. In addition, at least two further technical papers will be prepared and submitted for publication: one on the influences of salmon on grizzly bears in coastal B.C., and another on the security cover removal experiment.

Table 46. Completion plan timetable

| Management products | 1986/87 | | | | 1987/88 | | | | 1988/89 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 1 | 2 | 3 | 4 | 1 | 2 | 3 | 4 |
| Level 1 | | | | | | | | | | | | |
| establish bio criteria | x | | | | | | | | | | | |
| establish mgt. criteria | x | | | | | | | | | | | |
| ranking workshop | | x | | | | | | | | | | |
| draft product | | x | | | | | | | | | | |
| final product | | | x | | | | | | | | | |
| Level 2 | | | | | | | | | | | | |
| confirm need | x | | | | | | | | | | | |
| establish committee | x | | | | | | | | | | | |
| develop thresholds | | | | x | | | | | | | | |
| reach length/BHU | | | | x | | | | | | | | |
| model completion | | | | x | | | | | | | | |
| training | | | | | x | x | | | | | | |
| Level 3 | | | | | | | | | | | | |
| establish committee | x | | | | | | | | | | | |
| prescription details | | | | | | | | | | | | |
| draft | | | x | | | | | | | | | |
| final | | | | | | | | | | | | |
| field verification | | x | x | | | | | | | | | |
| product completion | | | | | | | | | | | | |
| draft | | x | | | | | | | | | | |
| final | | | | | | | | | | | | |
| product transfer | | | | | | | | | | | | |
| watershed selection | | | | x | | | | | | | | |
| demonstration workshops | | | | | | | x | | x | x | | |
| Technical Products | | | | | | | | | | | | |
| grizzly monograph | | | | | | | | x | | | | |
| Hamilton's thesis | | | | | | | | | | | | |
| Cornice paper | | | x | | | | | | | | | |
| salmon/grizzly paper | | | | x | | | | | | | | |

6.1 Table of Contents of Coastal Grizzly Monograph.

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Appendix A. Black bear capture summary 1982-1985.

| | ID # | NAME | AGE AT CAPTURE | CAPTURE DATE | NOSE-TAIL LENGTH (mm) | HEART GIRTH (mm) | FRONT PAD WIDTH (mm) | ZYGOMATIC WIDTH (mm) | CBL* (mm) | ESTIMATED WEIGHT (lbs) | RECAPTURE DATES |
|---|---|---|---|---|---|---|---|---|---|---|---|
| FEMALES | 14 | LILY | 5 | 050682 | 1460 | 730 | 89 | 190 | 285 | 200 | - |
| | 18 | JUNE | 4 | 100682 | 1445 | 688 | 107 | 185 | 170 | 200 | - |
| | 22 | MAGGIE | 12 | 290682 | 1310 | 680 | 90 | 210 | 295 | 100 | 070782 |
| | 45 | TENEE | 3 | 150583 | 1314 | 670 | 85 | 164 | 273 | 129 | - |
| | 52 | UNNAMED | - | 130984 | 1440 | 745 | 98 | 210 | 275 | 300 | - |
| MEAN | | | 6.0 | | 1393.8 | 702.6 | 93.8 | 191.8 | 291.6 | 185.0 | |
| MALES | 3 | CURT | 7 | 090582 | 1600 | 875 | 127 | 240 | 320 | 200 | - |
| | 4 | SKUCE | 7 | 100582 | 1700 | 945 | 105 | 185 | 295 | 165 | - |
| | 6 | SITKA | 14 | 150582 | 1805 | 888 | 123 | 209 | 309 | 290 | - |
| | 7 | TSUGA | 8 | 160582 | 1690 | 860 | 103 | 239 | 285 | 165 | 170583 |
| | 10 | JACK | 16 | 170582 | 1715 | 1045 | 114 | 225 | 315 | 290 | - |
| | 12 | LENNY | 4 | 310582 | 1410 | 760 | 107 | 175 | 295 | 165 | 090782,250485 |
| | 13 | CHESTER | 6 | 030682 | 1375 | 805 | 103 | 235 | 325 | 198 | - |
| | 15 | CLYDE | 16 | 060682 | 1710 | 932 | 113 | 230 | 295 | 290 | - |
| | 16 | DILLINGER | 3 | 080682 | 1485 | 740 | 112 | 180 | 285 | 200 | 290682 |
| | 17 | WALLY | 3 | 090682 | 1435 | 760 | 102 | 192 | 270 | 220 | - |
| | 19 | SAM | 7 | 100682 | 1710 | 955 | 126 | 230 | 305 | - | - |
| | 20 | HORIE | 3 | 100682 | 1335 | 678 | 96 | 190 | 260 | - | 280882,070884,280485 |
| | 21 | DALE | 20 | 200682 | 1976 | 852 | 110 | 219 | 286 | 150 | - |
| | 23 | FRITZ | 10 | 290682 | 1665 | 939 | 122 | 235 | 330 | 290 | 240882 |
| | 30 | TEDDY | 8 | 180782 | 1705 | 835 | 105 | 210 | 317 | 200 | - |
| | 29 | YOGI | 18 | 240782 | 1730 | 940 | 117 | 220 | 310 | 200 | - |
| | 31 | ALBERT | 3 | 240782 | 1360 | 720 | 90 | 175 | 300 | 100 | 270782 |
| | 32 | BOOBOO | 3 | 240782 | 1410 | 730 | 110 | 180 | 290 | 100 | - |
| | 33 | LEROY | 7 | 240782 | 1995 | 1000 | 110 | 210 | 330 | 200 | - |
| | 35 | CUBBY | 4 | 050583 | 1155 | 775 | 107 | 235 | 325 | 200 | - |
| | 36 | SPAZ | 5 | 070583 | - | 755 | - | - | - | 200 | - |
| | 37 | TOBY | 5 | 080583 | 1540 | 760 | 110 | 195 | 295 | 200 | - |
| | 39 | MORRIS | 5 | 090583 | 1515 | 790 | 110 | 195 | 325 | 190 | - |
| | 40 | LUTHER | 9 | 090583 | 1760 | 1070 | 125 | 230 | 330 | 300 | - |
| | 42 | CHARLIE | 6 | 110583 | 1520 | 740 | 109 | 180 | 298 | 200 | 070884 |
| | 43 | ERNIE | 5 | 120583 | 1520 | 780 | 105 | 209 | 316 | 125 | - |
| | 48 | HERBIE | 5 | 210884 | 1270 | 702 | - | 180 | 295 | 80 | - |
| | 49 | NO NAME | 2 | 240884 | 1595 | 845 | 115 | 229 | 295 | - | - |
| | - | NAMELESS | 4 | 090984 | 1750 | 1040 | 125 | 225 | 305 | 250 | - |
| | - | ANON | - | 020585 | 1840 | 1160 | 115 | 180 | - | - | - |
| | 55 | #18 | - | 080985 | - | - | - | - | - | 125 | - |
| MEAN | | | 7.3 | | 1568.1 | 855.1 | 111.4 | 208.6 | 303.6 | 188.6 | |

Grizzly bear capture summary 1982-1985.

| | ID # | NAME | AGE AT CAPTURE | CAPTURE DATE | NOSE-TAIL LENGTH (mm) | HEART GIRTH (mm) | FRONT PAD WIDTH (mm) | ZYGOMATIC WIDTH (mm) | CBL (mm) | ESTIMATED WEIGHT (lbs) | RECAPTURE DATES |
|---|---|---|---|---|---|---|---|---|---|---|---|
| FEMALES | 5 | SANDY | 10 | 110582 | 1920 | 990 | 147 | 240 | 345 | 300 | - |
| | 8 | MARSHA | 13 | 170582 | 1895 | 1155 | 139 | 235 | 380 | 300 | 110782,210485 |
| | 11 | JENNY | 2 | 170582 | 1197 | 689 | 106 | 195 | 285 | 70 | 160583 |
| | 24 | COLLEEN | 1 | 030782 | 1400 | 730 | 129 | 195 | 270 | 155 | - |
| | 25 | SHELLY | 16 | 080782 | 1785 | 1085 | 140 | 265 | 380 | 350 | - |
| | 47 | LOUISE | 11 | 190583 | - | - | - | 240 | 405 | 300 | - |
| | 50 | HEATHER | 9 | 020984 | 1690 | 932 | 129 | 245 | 359 | 200 | - |
| MEAN | | | 8.9 | | 1647.8 | 930.2 | 129.7 | 230.7 | 342.9 | 239.3 | |
| MALES | 1 | JASON | 12 | 070582 | 2160 | 1330 | 165 | 330 | 440 | 300 | - |
| | 2 | STANLEY | 2 | 090582 | 1805 | 910 | 155 | 240 | 355 | 225 | 110583 |
| | 9 | BILLY | 1 | 170582 | 1185 | 655 | 105 | 70 | 170 | 60 | - |
| | 26 | LOUIS | 8 | 090782 | 2185 | 1285 | 175 | 325 | 440 | 495 | - |
| | 27 | JAMIE | 1 | 120782 | 1295 | - | 112 | 175 | 385 | 100 | 180782 |
| | 28 | STUART | 1 | 150782 | 1315 | 785 | 112 | 110 | 315 | 100 | - |
| | 34 | EARL | 11 | 310882 | 2335 | 1405 | 185 | 335 | 465 | 600 | - |
| | 38 | CAESAR | 17 | 080583 | 2300 | 1700 | 200 | 300 | 460 | 700 | 130583 |
| | 44 | SONNY | 13 | 130583 | 2225 | 1200 | 150 | 280 | 390 | 350 | - |
| | 46 | AMOS | 3 | 160583 | 1650 | 830 | 123 | 200 | 350 | - | - |
| | 41 | ANDY | 3 | 180583 | 1610 | 910 | 130 | 210 | 360 | 275 | - |
| | 53 | HENRY | 3 | 210884 | 1870 | 1070 | 158 | 270 | - | 400 | 010585 |
| | 54 | BRUTUS | 6 | 250485 | 2145 | 1374 | 165 | 295 | 450 | 600 | - |
| MEAN | | | 6.2 | | 1852.3 | 1121.2 | 148.8 | 241.5 | 381.7 | 350.4 | |

*CBL = Skull length

APPENDIX B. Ecosystem associations in the Kimsquit watershed.[a]

| | Ecosystem association | Association name | Variations |
|---|---|---|---|
| | 301 | Zonal hemlock-(Douglas-fir) -Vaccinium - moss | 1. Herb<br>2. amabilis fir-Rhytidiopsis robusta<br>3. Nudum |
| | 302 | Dry Douglas-fir - pine - salal - Pleurozium - lichen | 1. Vaccinium |
| | 303 | Submesic - hemlock - moss | 1. Douglas-fir - salal<br>2. Vaccinium |
| | 304 | Oak fern - moss | 1. Douglas-fir - sword fern<br>2. Nudum |
| | 305 | Devil's club - fern | 1. Cottonwood-spruce-salmonberry-devil's club<br>2. Alder-salmonberry-elderberry<br>3. Alder-salmonberry-pole sapling<br>4. Salmonberry-thimbleberry-lady fern-shrub |
| CWHh3 | 306 | Floodplain spruce - devil's club | 1. Cottonwood-spruce-salmonberry-devil's club<br>2. Cottonwood-devil's club-salmonberry<br>3. Cottonwood-alder-salmonberry-devil's club<br>4. Alder-salmonberry-elderberry<br>5. Alder-salmonberry-pole sapling<br>6. Alder-grass<br>7. Salmonberry-thimbleberry-lady fern-shrub<br>8. Alder-willow-fireweed-Rhacomitrium-gravel/sandbar<br>9. Cottonwood-alder-twinberry young seral<br>10. Spruce-cottonwood-thimbleberry-devil's club-pole sapling young seral |
| | 307 | Skunk cabbage swamps | |
| | 308 | Non-forested wetlands | |
| | 309 | Avalanche tracks and rock slides | |

[a] Successional stages:
A non-vegetated or bryoid
B herb pioneer seral
C shrub-seedling pioneer seral
D pole-sapling young seral
E mature seral
F young climax
G mature climax
H old growth

APPENDIX B. Ecosystem associations in the Kimsquit watershed.[a]

| | Ecosystem association | Association name | Variations |
|---|---|---|---|
| | 301 | Zonal hemlock-(Douglas-fir) -Vaccinium - moss | 1. Herb<br>2. amabilis fir-Rhytidiopsis robusta<br>3. Nudum |
| | 302 | Dry Douglas-fir - pine - salal - Pleurozium - lichen | 1. Vaccinium |
| | 303 | Submesic - hemlock - moss | 1. Douglas-fir - salal<br>2. Vaccinium |
| | 304 | Oak fern - moss | 1. Douglas-fir - sword fern<br>2. Nudum |
| | 305 | Devil's club - fern | 1. Cottonwood-spruce-salmonberry-devil's club<br>2. Alder-salmonberry-elderberry<br>3. Alder-salmonberry-pole sapling<br>4. Salmonberry-thimbleberry-lady fern-shrub |
| CWHh3 | 306 | Floodplain spruce - devil's club | 1. Cottonwood-spruce-salmonberry-devil's club<br>2. Cottonwood-devil's club-salmonberry<br>3. Cottonwood-alder-salmonberry-devil's club<br>4. Alder-salmonberry-elderberry<br>5. Alder-salmonberry-pole sapling<br>6. Alder-grass<br>7. Salmonberry-thimbleberry-lady fern-shrub<br>8. Alder-willow-fireweed-Rhacomitrium-gravel/sandbar<br>9. Cottonwood-alder-twinberry young seral<br>10. Spruce-cottonwood-thimbleberry-devil's club-pole sapling young seral |
| | 307 | Skunk cabbage swamps | |
| | 308 | Non-forested wetlands | |
| | 309 | Avalanche tracks and rock slides | |

[a] Successional stages:
A non-vegetated or bryoid
B herb pioneer seral
C shrub-seedling pioneer seral
D pole-sapling young seral
E mature seral
F young climax
G mature climax
H old growth

APPENDIX B (continued)

| | Ecosystem association | Association name | Variations |
|---|---|---|---|
| | 01 | Zonal mountain hemlock - Amabilis fir - Vaccinium - moss | |
| | 02 | Submesic mountain hemlock- (Amabilis fir - Vaccinium) - moss | |
| | 03 | Moist hemlock - Amabilis fir - Vaccinium - fern[a] | |
| | 04 | Lady fern | |
| CWHi3 | 05 | Devil's-club - fern - leafy moss | |
| | 06 | Floodplain spruce - Devil's-club | |
| | 07 | Skunk cabbage | |
| | 08 | Sitka mountain alder - Lady fern avalanche track | |
| | 09 | Sedge fen | |

[a] Little data exist to support the 03 association and none for the 04 association described by Yole et al. (1982) . For descriptive and mapping purposes, these two associations have been conglomerated with 05.

| | Ecosystem association | Association name | Variations |
|---|---|---|---|
| | 01 | Zonal mountain hemlock -Vaccinimu - moss | |
| | 02 | Submesic mountain hemlock - moss | |
| MHd | 03 | Subhygric mountain helmock - lady fern - sitka valerian | |
| | 04 | Sedge - Sphagnum wetland | |
| | 05 | Sitka mountain alder - willow - Sitka valerian avalanche track | |

| | Ecosystem association | Association name | Variations |
|---|---|---|---|
| | 01 | Zonal mountain hemlock - Cassiope - Cladina | |
| MHdp | 02 | Submesic mountain heather - Cassiope | |
| | 03 | Subhygric Copperbush - Sitka valerian - Sphagnum | |

FISH & WILDLIFE BRANCH
RESEARCH SECTION

# SITE INVESTIGATION FORM

FORM # _____ (1)

## SITE CHARACTERISTICS

SITE # (6)

DATE D D M M Y Y (9)

SURVEYORS (15) (17) (19)

X-COORD (21)

Y-COORD (28)

PLOT SIZE (m) (31)

ELEVATION (m) (35)

SLOPE (39)

ASPECT (42)

## HABITAT CHARACTERISTICS

TYPE (45)

POLYGON (51)

STRATA %
TREE (55) B1 (57) B2 (59) C (61) D (63)

COVER VALUE
N (65) E S W

TYPE (73)
1 Shrubs
2 Debris
3 Topography
4 Trees
N E S W

TRAFFIC (circle 1 max) (77)
1 Unrestricted
2 Slight
3 Restricted
4 Very
5 Extreme

SOIL TYPE (78)

MOISTURE (81)

NUTRIENT (84)

HUMUS (85)

SURFACE TEX (87)

SURFACE SUBSTRATE %
LITTER (91) HUMUS (93) DECAY WOOD (95) BEDROCK (97) ROCKS (99) MINERAL SOIL (101) H20 (103)

FLOODING (circle 1 max) (105)
1 Now
2 1 Month
3 This Year
4 Not Active

## ACTIVITY CHARACTERISTICS

ACTIVITY (circle 6 max) (108-111)
1. Bed
2. Feed
3. Mark Tree
4. Mark Trail
5. Travel
6. Other _____ SPECIFY
* = Primary Activity

SEASON (circle 1 max) (112)
1. Leaf Flush
2. Chute Greenup
3. Berry Production
4. Berry to Salmon
5. Berry & Salmon
6. Salmon
7. Post Salmon

WX AT USE (circle 1 max) (113)
1. Unknown
2. Rain
3. Intermittant Rain
4. Overcast
5. Cloudy
6. Few Clouds
7. CA/U
8. Other _____ SPECIFY

USE/RELOC DATE
D D M M Y Y (114)

SIGN AGE (120)

BEAR # (122)

RELOC SHEET # (124)

TELEMETRY RELIABILITY (circle 1 max) (127)
1. Positive
2. Probable
3. Possible
4. Doubtful

VERIFICATION (circle 7 max) (128-134)
1. Hair
2. Tracks
3. Telem
4. Visual
5. Age
6. Scat
7. Disturbance

BED MEASUREMENTS
LENGTH (135) WIDTH (138)

OTHER BEARS #
1 (141) 2 (143) 3 (145)

DEPTH (147) BED TREE (149) D B H (152)

MARK TRAIL
LENGTH (155) IMPRESSIONS (157)

STATUS (circle 1 max) (159)
1. Permanent
2. Occasional

MARK TREE
SPECIES (160) D B H (162) HT MARKED (165) AGE (168)

FOOD SPECIES (order of use)
1 (171) 2 3 4 5

FOOD SAMPLE LABELS
SITE # (178) FOOD SITE # FOOD SITE # (184) FOOD SITE # FOOD SITE # FOOD

OTHER WILDLIFE
(circle 5 max) (198-200)
1. Moose
2. Deer
3. Black Bear
4. Goat
5. Wolf
6. Other _____ SPECIFY

OTHER WILDLIFE USE
(circle 5 max) (210-205)
1. Bed
2. Browse
3. Graze
4. Dig
5. Tracks
6. Scat/Pellets
7. Other _____ SPECIFY

CONTINUE ON REVERSE

## SITE INVESTIGATION FORM CONTINUED

### DISTANCE MEASURES

TO OPENING (m) (206)

HABITAT TYPE (209)

TO COVER (m) (214)

TYPE OF COVER (217)

COVER VALUE (223)
N E S W

COVER TYPE (231)
N E S W

TO HUMAN ACT (m) (235)

ACTIVITY TYPE
(circle 2 max)
(239-240)
1 Road
2 Clear Cut
3 Air Strip
4 Camp
5 Dry Land Sort
6 Spur Road
7 Other _____
SPECIFY

CURRENT USE
(circle 2 max)
(241-242)
0 None
1 Telemetry Vehicle
2 Care Taker
3 Falling/Bucking
4 Yarding/Loading
5 Hauling
6 Sorting
7 Road Construction
8 Oil Operation
Other _____
SPECIFY

WITHIN ZONE ONLY
AXIS COVER VALUE (243)

COVER TYPE (245)

NOISE LEVEL (248)

COMMENTS _____

TO WATER (m) (249)

SALMON AVAILABILITY
(circle 1 max)
(252)
1 None
2 Low
3 Medium
4 High

SALMON ABUNDANCE
(circle 1 max)
(253)
1 None
2 Low
3 Medium
4 High

TO PREDOMINATE
ASSOCIATED HABITAT (m) (254)

HABITAT TYPE (257)

COVER VALUE (263)
N E S W

DESCRIPTION

PHOTO # (271)

FILM # (277)

SCAT # (279)

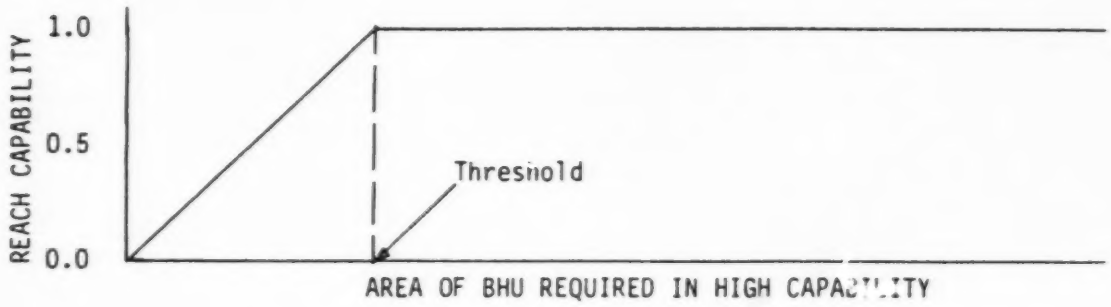
### SITE DIAGRAM

N

### COMMENTS

APPENDIX D. Threshold determination and the relationship of thresholds to management products.

Thresholds will be estimated for all BHU's that have high seasonal quality values (Table 42). These estimates will be best guesses based on information from Shelly and Marsha and will be presented in the following format: area of BHU required per reach length in high grizzly capability.




We have selected season 4, the berry season, to illustrate the relationship between thresholds and management products.

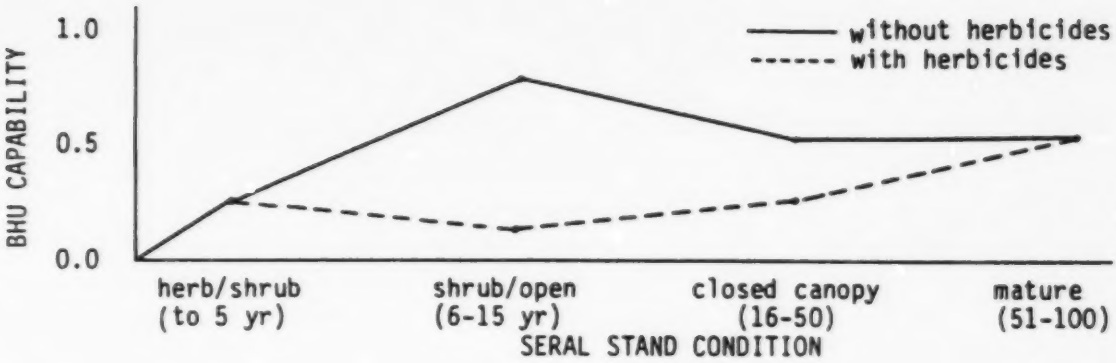
Steps:

1. We identify the BHU's in season 4 that have high relative quality values (Table 42) and predict the impacts of logging this BHU on its capability to support grizzlies. These predictions will be made in a workshop with forest ecologists. We selected the floodplain oldgrowth BHU for this example.

2. The FO BHU is first divided into 4 seral stand conditions:

   a. herb/shrub
   b. shrub/open canopy
   c. closed canopy
   d. mature

3. We predict the impacts of logging this BHU on its capability to support grizzlies over the rotation age of the stand. For this example we have predicted impacts with and without the application of herbicides (see following figure). We assume standard coastal logging techniques and basic silviculture.




4. We determine the number and area of FO BHU's in the reach length.

5. We ensure that reach capability is maintained above the threshold for FO. We can use the logging impact Figure (in point 3 above) to predict what areas in each seral stand condition will be required to ensure that the FO threshold is maintained.